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# THE PRACTICAL IMPORTANCE OF MECHANICS IN DIGESTION*

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NOWADAYS, no physician attempts the definite diagnosis of an esophageal, thoracic or abdominal lesion without the aid of a roentgen examination. This roentgenological success, however, is no argument that we should not have made greater progress and obtained more accurate work if we had had a groundwork of physiology based on roentgenological findings, and, in point of fact, there is just as big a revolution possible in physiology by means of roentgenology as has already taken place in pathology. In this brief paper, I wish to write of some of the changes in outlook on certain phases of the mechanics of digestion that have resulted from the roentgenological study of the subject.

May I in the first place remind you of the teaching that is current as to the mechanics of swallowing? You will probably remember the graphs that are published in the physiology books which show the very strong positive pressures that are supposed to propel the food down the pharnyx and esophagus; these graphs were obtained in 1883 by Kronecker and Meltzer. The method employed was to insert a balloon into the pharynx and esophagus, then, having distended it to some extent, the pressures during the act of swallowing were recorded. When you come to think of it, such a proceeding could not record a normal act, but would be comparable to the mechanism we employ when we attempt to swallow a large lump of food which sticks, for the balloon did not move on. Nature is extremely cunning and always has alternative mechanisms available for every function. She employs a number of forces and balances these in different ways in order to deal with varying conditions. The mechanism employed for swallowing a bolus that sticks is very different from that generally used. Nor do we all accomplish the action of swallowing, or any other function, in exactly the same way, even for the same type of food, as the textbooks seem to indicate. We are all individuals and there is no standard. Hence, we find that in swallowing, some persons may to a slight extent employ the method of propulsion that is described in the textbooks, but most of us swallow ordinary well-masticated food in a very different way, namely, by suction. This may sound revolutionary, but it is common sense, as we realize when we think of the infant at the breast that sucks its food, or the animal that we see obviously drawing

* Read at the Annual Fall Clinical Conference, Kansas City, Mo., October 4, 1937.

FIG. 1. *A*, normal pharynx at rest, showing the large cavity of the pharynx and the epiglottis standing up between the arms of the hyoid bone. *B*, the closed phase of the pharynx that *precedes* the propulsion of the food from the back of the tongue. It lasts for only about 1/20 to 1/10 second. Note that the hyoid rises up to below the lower jaw, that the pharynx is completely obliterated, apparently by the tongue going backwards and downwards between the arms of the hyoid. The laryngeal vestibule is also obliterated as far as the false vocal cords. There is a small amount of air in the esophagus behind the trachea, presumably squeezed down there by the closure of the pharynx by the tongue.

liquid, or even solid food into its esophagus.

Most of you have watched the mechanism of swallowing on the fluorescent screen, and for many years we have taken it for granted that what we saw on the screen was the expression of the teaching of the physiology books. But when we attempted the difficult task of analyzing what we saw, we realized that we had to reconsider our views. The difficulty of making observations lay in the speed with which the act of swallowing was accomplished. We now find that it takes only about one-eight of a second for food to pass from the back of the tongue to the level of the clavicle. From screen observations and from numerous serial films (3 taken in 1½ seconds) we noted that the cavity of the pharynx was obliterated *before* the food was pushed off the back of the tongue (Fig. 1), and that the "tail" of the bolus lagged behind in the pharynx and upper esophagus in much the same way as the tail of a drop of, say, syrup, falling from a spoon (Fig. 2), i.e., the bolus did not give the impression of being propelled, but rather of falling through space. Watching the mechanism in hundreds of students, it was clear that after the food left the back of the tongue it was carried by suction, and went with one hop straight down to the level of the clavicle, where the mechanism changed. (Elsewhere I* have given details of the mechanism by which this negative pressure is produced.)

At this point, about the junction of the upper and middle thirds of the esophagus, certain changes in structure are noted. First, the voluntary muscle gives place to involuntary muscle. Second, the muscularis mucosae begins to appear at this point. Third, the nerve supply in the floor of the fourth ventricle for the upper section

* The Digestive Tract. Macmillan Co., 1937.

is separate from that which supplies the lower two-thirds. Incidentally, this is the point at which swallowed coins, etc., tend to lodge. All this suggests that the mechanism would be likely to change at this point. We therefore consider the mechanism of deglutition as occurring in three stages: (1) the voluntary act that pushes the food off the back of the tongue into the pharynx, (2) the swallowing act, largely involuntary, that carries the bolus from the back of the tongue to the level of the clavicle, and (3) the involuntary and entirely automatic mechanism that carries the food on to the cardiac orifice.

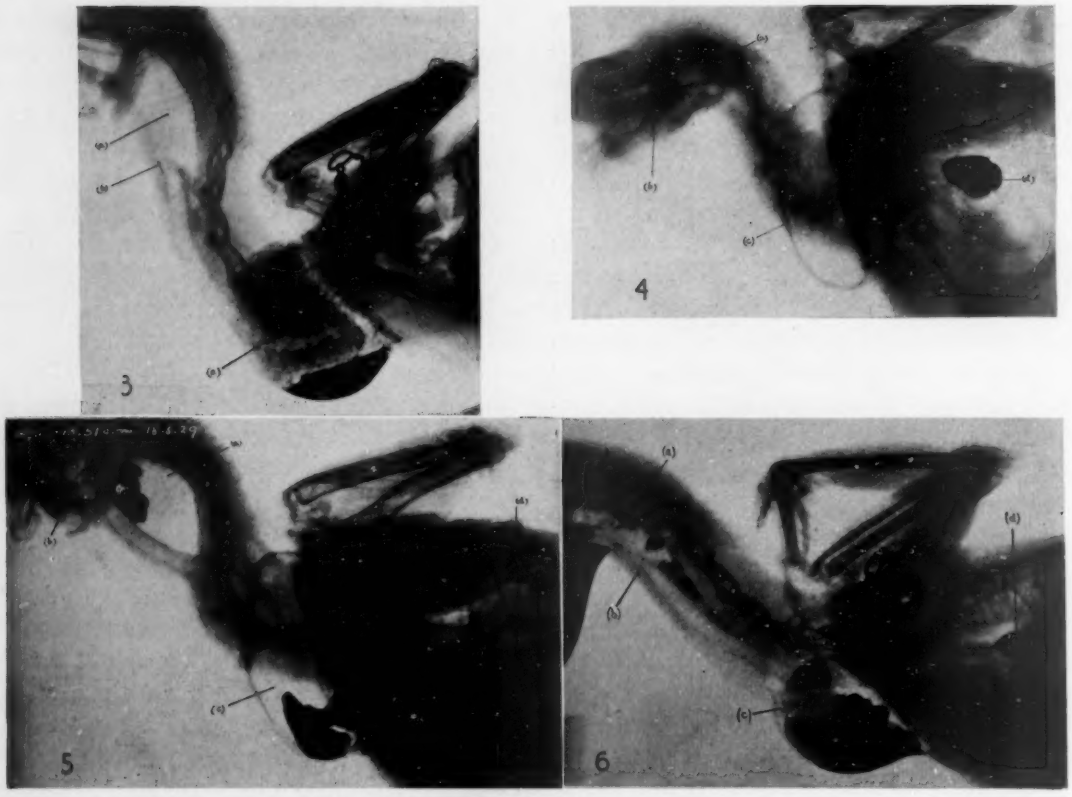
It is an essential condition for normal swallowing that the mouth, nasopharynx and larynx should be closed off from the pharynx during the act. The mechanisms of the closure of the mouth and nasopharynx are readily appreciated, but it is not so easy to understand how the larynx is closed and protected from the food as it passes down. Apparently this is accomplished not only by the approximation of the laryngeal cartilages, but the esophagus appears to be pulled up behind the laryngeal opening to protect it. This is confirmed by the character of the mucous membrane, squamous epithelium covering the tip of the epiglottis and giving place almost immediately to ciliated epithelium, indicating that the latter parts are entirely protected from the flow of the food.

I also made some studies in animals, particularly the hen, roentgenograms of which indicate a similar mechanism (Figs. 3, 4, 5 and 6). Recently, roentgen cinematography has been possible and I have obtained films* of rats, guinea pigs and hens, and although in these one cannot see the pharyngeal space, one can readily detect evidence of a similar mechanism.

Having convinced myself by means of roentgen studies that negative pressure was a fact, I invited the cooperation of a physiologist, Professor Anrep. In human subjects, a catheter, connected by a tube to a rubber diaphragm bearing a minute mirror, was introduced through the nose. A beam of reflected light from the mirror was thrown on to a recording camera (Fig. 7). Somewhat to the astonishment of my colleague, the records of negative pressure were so definite and of such an order that the thin India rubber tambour had to be replaced by the thick rubber of a tobacco

* These films were shown at the meeting.

Fig. 2. A series of three roentgenograms taken in 1½ seconds. *A*, taken too soon, i.e., before the patient has swallowed and before the closure of the pharynx, shown in Figure 1*B*. Yet in *B*, perhaps half a second later, the food has passed right down and has almost left the field. Also the pharynx has opened up again. A trace is left in the vallecula in front of the epiglottis, and apparently the esophagus is open and above the bolus and smeared with traces of the food. The shadow of the food is in the shape of a drop. In *C* the "drop" has passed out of sight and traces of the rather sticky food are left in the vallecula, sinus pyriformis, and esophagus.



A HEN SWALLOWING

FIG. 3. Note the large pharynx (*a*), the position of the larynx (*b*) half way down the neck, and the crop (*c*) full of mash with some opaque food in it.

FIG. 4. The hen leans forward to swallow and the pharynx (*a*) is practically obliterated, while the larynx (*b*) rises right up in the neck to a position underneath the tongue, and the crop (*c*) is distended by air. A bolus (*d*) is going down towards the gizzard.

FIG. 5. The hen has just swallowed. Note that the pharynx (*a*) (which is now, according to anatomical description, the esophagus, owing to the way the trachea has risen) is distended, that the larynx (*b*) is still right up underneath the tongue, and that the bolus from the mouth has been sucked, or propelled, into the distended esophagus, through which it will be carried mostly by propulsion and by the retraction of the esophagus down to its normal position. The crop (*c*) is distended with air and contains some opaque food. The bolus (*d*) is being propelled down to the gizzard.

FIG. 6. The hen is reaching forward for more food, but has not yet started swallowing again. The sticky food is adhering to the walls of the pharynx (*a*) and the larynx (*b*) has come down to its normal position. The crop (*c*) contains air and opaque food. The bolus at the top of the crop was seen to divide and half of it dropped into the crop while the other portion (*d*) went on towards the gizzard.

pouch. Figure 8 shows a typical graph that we obtained by this method. It will be noted that there is an initial very slight rise of pressure (due to the closure of the pharynx) followed by a very marked fall. In the graph the vertical lines indicate one-twenty-fifth of a second, so that the negative pressure lasts for only about one-eighth of a second. As for the actual pressures involved, we found by manometer readings that in swallowing dry bread I exerted a negative pressure of 18 inches of water!

Some of the many students examined used negative pressure far more than others, but even in the latter, when we

obtained records, we found that, in spite of appearances, they were actually employing negative pressure, though not to the same extent. It looked, however, as if suction might readily give place to propulsion if there was the slightest difficulty.

My main object in this paper is to emphasize the adaptability of Nature's mechanics. There is no one normal mechanism for any function—a number of forces are used and Nature balances these in varying proportions to achieve the same result, whatever the conditions. The mechanics of swallowing are a good example of this: if we swallow a bolus too large or too thick to be sucked down, then the reserve mechanism of propulsion comes into play.

From the level of the clavicle down to the cardiac orifice, I do not yet know how the food normally travels, although I have watched it critically for years. A *lump* of food is propelled by peristalsis, but ordinary, well-masticated food may pass down without any sign of peristalsis, even when the subject is lying down, i.e., gravity, although it helps, is not an essential factor. If the bolus is too large, however, or if there is any obstruction, then peristalsis comes into play and forces the food along—that is to say, peristalsis is a reserve, and not the essential primary mechanism of propulsion.

For the mechanics of gastric movement the old textbooks of physiology relied on the work of Beaumont and his experiments on Alexis St. Martin, who had survived from a gunshot wound through the stomach and who had a gastrostomy for the rest of his days. A hundred and five years ago Beaumont took this man to medical schools in Canada and the United States, exhibiting him and demonstrating what he saw, and for a hundred years the mechanics and chemistry of the stomach have been very largely based on his work. In a textbook of physiology, published in 1929, this was still the authority—roentgenology and what it has taught us was hardly mentioned. The stomach was described as being in two parts, an upper part—the hopper—in which the food was stored, and a lower part, in which it was churned. Today, every medical man knows that the stomach is one cavity and that the food is not churned within it to any extent, but I well remember a heated controversy in one of our medical journals just before the War, in which I had difficulty in maintaining this elementary fact against surgeons and anatomists who held that the stomach consisted not only of two, but possibly even of three sacs. Of course they based their views on the distorted caricatures of the stomach that result from fixation and

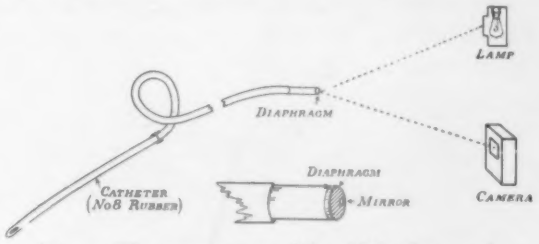



Fig. 7. The apparatus with which the graphs (Fig. 8) were obtained.

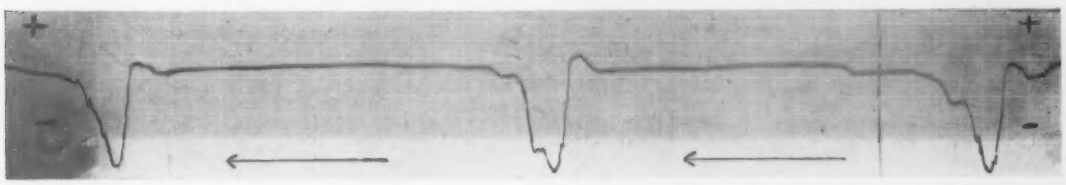



Fig. 8. A typical graph. Reading from right to left, it shows a slight rise of pressure just before swallowing and a very marked fall during the act. The vertical lines represent one-twenty-fifth of a second, so that the duration of the negative pressure was about one-eighth of a second. The pressures in this case (swallowing dry bread) were equivalent to 18 inches of water negative pressure, as measured by manometer.

death. Towards the pyloric end, peristaltic waves may mix the food up, but this mixing is not an essential mechanism, and, in point of fact, if the food contains no lumps, we often see the stomach emptying perfectly well without any churning at all by

FIG. 9. *A*, duodenal cap; *B*, pylorus. The stomach emptying into the duodenal cap with practically no peristalsis.

peristalsis (Fig. 9). The main propelling force in such circumstances is, presumably, the intragastric pressure due to the tonus of the gastric muscle. We find that in the stomach, as elsewhere, peristalsis, which we used to regard as the one essential mechanism, is a reserve force that is called into play whenever there is relative obstruction at the pylorus, either from a failure to open or owing to the presence of an unmasticated lump of food. When there is actual obstruction, either spasmodic or organic, then peristalsis may become extremely violent in its efforts to overcome the obstruction (Fig. 10). I still vividly recall the first of these rare cases that I saw thirty years ago, in which the stomach writhed in its efforts to overcome an acute obstruction, due to a carcinoma of the pylorus—it reminded me of a life and death struggle. I have not time, however, to go into the complex question of the control of the pylorus—suffice it to say that it does not open in response to peristaltic waves or to any change in the acidity of the gastric contents. I believe it is chiefly controlled by a reflex mechanism in the small intestine, probably centered in the region of the ileocecal valve.

To turn now to the duodenum. Every doctor who has seen a roentgen report knows that the first part of the duodenum is different from the rest. The food outlines it as a solid mass that takes the shape of a cardinal's hat, the "duodenal cap." In it we see no peristalsis and very little change of shape. The peristalsis from the stomach stops dead at the pylorus and does not pass into the duodenum (Fig. 11). The anatomical explanation of this is quite simple: the circular fibers of the stomach, on which peristalsis depends, stop at the pylorus,

FIG. 10. Excessive peristalsis of the stomach. Patient lying down.

and there are no such fibers in the first part of the duodenum; it is only after about 3/4 of an inch that the circular fibers begin to re-appear. Hence we get the formation of the duodenal cap, with its solid outline

and intermittent retention of food until the stomach is empty. Beyond this point, however, there is an immediate change of mechanism. The solid shadow of the food in the cap is broken up into a fine snowflake shower (Fig. 12), and how this is done we do not know, although we believe that it is largely due to the muscularis mucosae. There is no suggestion in any of the thousands of films that I have carefully examined that this shredding of the food is accomplished by peristalsis. In Figure 12 the outline of the lumen can readily be traced and it shows no sign of peristalsis.

This fragmentation of the food, however, does not always take place, especially in opaque meal examination technique, when large quantities of semifluid food are swallowed under hunger conditions and frequently run straight through to the empty intestine. In these circumstances the fragmentation mechanism may not be able to cope with the large quantities that pass the pylorus, and we see masses in the duodenum which are often subjected to peristaltic action (Fig. 13). This is the condition that we call duodenal ileus, and it may be quite a normal happening; but we must be on our guard here, for the same appearance may be due to obstruction at the duodenojejunal flexure. We learn to regard peristalsis in this region also as a reserve mechanism.

Fig. 11. *A*, duodenal cap. Normal stomach showing a peristaltic wave near the pylorus. These waves end at the pylorus and do not extend to the duodenal cap. Fragmented food is seen in the second part of the duodenum.

Fig. 12. *A*, duodenal cap; *B*, pylorus. Shows the duodenal cap well filled and the fragmented food outlining the second and third parts of the duodenum. The lumen can be traced and there is no suggestion of peristalsis.

As yet we know very little about the mechanics of the small intestine. So far as we have made out, it appears to be chiefly the action of the muscularis mucosae that not only keeps the food finely divided, so that the digestive juices may operate, but also propels it along its course. We only see peristalsis in the small intestine when the latter is overloaded and the food is in a mass. This may be due either to food leaving the stomach too rapidly or to some obstruction delaying its passage. In these circumstances peristalsis may become violent, obviously attempting to

propel the food rapidly through the gut. The unpleasant colicky pains which we experienced as children were due to powerful peristaltic waves, battering against a spasmodic obstruction that was caused by our little indiscretions of diet. In passing, I would have you remember that the

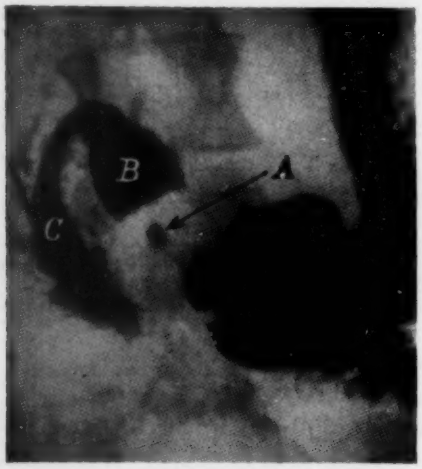



FIG. 13. *A*, a fragment of food just behind the pylorus; *B*, duodenal cap; *C*, second part of the duodenum. Rapid emptying through the duodenum, showing food passing through *en masse* into the second part of the duodenum. In the second part it was subject to peristalsis.

smooth, creamlike mixture we use for opaque meal work is considerably different from the lumpy, ordinary foods on which we live.

As the food approaches the ileocecal valve the intestinal movements become less active, the shadows become massed, and the outline of the gut is well defined (Fig. 14). The nearer we get to the end of the small intestine the less movement we see, and, in fact, in the last few inches the shadows are usually entirely static over long periods. It is generally difficult to obtain roentgenographic detail in this region because of the complexity of the coils and overlying shadows. In the few cases in which I have seen definite movement, it has not been the peristaltic wave that we should have expected, but a sudden rush of the contents of the last few inches of the ileum into the cecum, such as might well be the result of a single very powerful wave, or, less likely, a sudden spasm that synchronized with an opening of the "valve."

The cecum seldom shows any movement. The indentations of its outline change their positions, but we do not see any peristalsis, and the cecal shadow may remain almost unchanged over long periods. As no peristalsis is seen, the question arises as to how the food passes on from the cecum to the large intestine. Recently I made some cinematographic studies which show that the cecum has a definite contraction and expansion which we had not detected before —a systole and diastole—an action which, assisted by movements of respiration, appears to provide a pumping mechanism that pushes the food up into the large intestine. Whether this is continuous or intermittent we do not yet know.

FIG. 14. Food in the jejunum and ileum. The scattered snow-flake appearance in the jejunum gives place to a more definite shadow in the ileum where the movements are much slower and fragmentation is much less marked. The terminal ileum is shown. (Figure by courtesy of Dr. Graham Hodgson.)

In the large intestine proper there is no peristalsis in the accepted sense of the word. We may see the shadow, as in Figure 15, remaining unchanged hour after hour, except for small alterations in contour,

until what is known as a mass movement occurs. This mass movement, which was first described in 1911 by Holzknecht and shortly afterwards by myself, takes place only occasionally, perhaps three times a day, perhaps only once daily, or even at less frequent intervals in some individuals, and in spite of the very big change in the distribution of the contents, the subject is entirely unconscious that anything has occurred in the abdomen. The contents of the colon are seen to move very rapidly in a mass through a long section of the intestine and they sometimes seem to rebound to some extent. It is not necessarily followed by a call to stool or any other sensation. Figure 16, taken from Holzknecht's original paper,

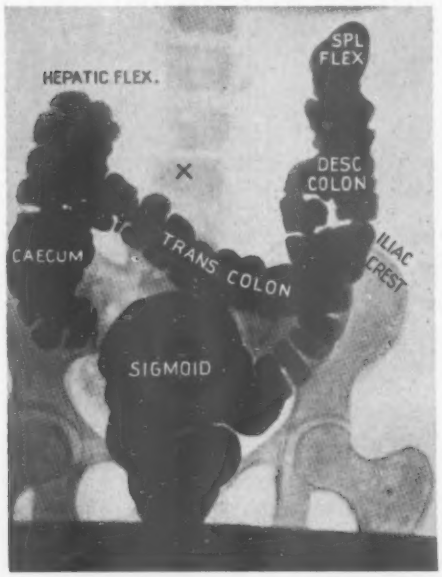



Fig. 15. A normal, well-filled, large intestine, showing the haustral segmentations.

shows (1) the normal haustrated colon, (2) the relaxation of the haustra, followed by (3) the rush of the contents from the transverse colon right round to the sigmoid flexure. He had only seen the movement twice when he described it; in both instances it was all over in a few seconds. Yet, in the absence of other observed movements, he rightly claimed that this was the normal movement of feces through the large intestine. Very little, if anything, has been added to Holzknecht's original description, for, in routine examinations, the movement is seldom seen. Moreover, it occurs so unexpectedly and is over so rapidly that the observer is taken unawares.

In addition to the mass movement, there are some relatively slight contractions in

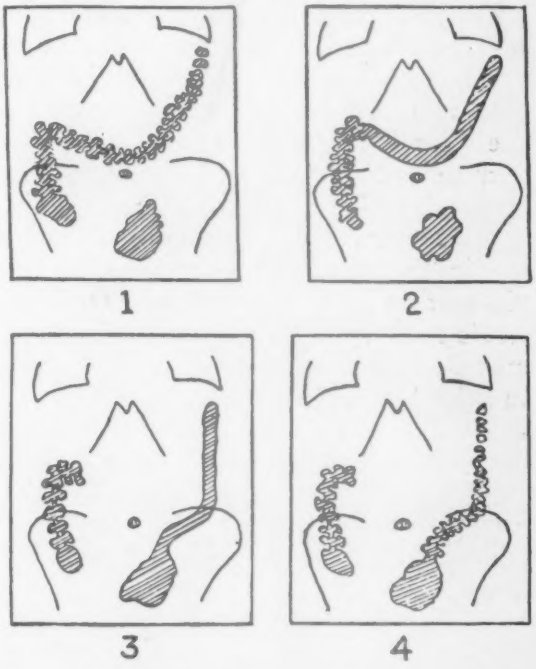



Fig. 16. Holzknecht's diagrams of the happenings in mass movements of the large intestine. *1*, distribution of the food before any change was noted; *2*, the haustral segmentation in the transverse colon has disappeared. No point d'appui is seen; *3*, the whole colon beyond the hepatic flexure passes on suddenly; *4*, it is again a picture of still life a few seconds later and the haustral segmentation has returned.

the large intestine that result in change of the outline of the haustral segmentations. I have made some cinematographic studies which show that these alterations in contour are not propelling the contents but merely mixing them. It is interesting to find that pellets of bismuth, coated with celluloid to prevent disintegration, are very slowly moved round, more or less in circles, by these slow movements, i.e., the feces are being turned over and brought into con-

tact with the mucous membrane by these haustral movements. The mass movement and this alteration in the contour of the haustra (haustral movements) are the only intrinsic movements of the large intestine that we can detect.

The importance of the observation of mass movement on the subject of constipation is, of course, obvious, and it has not, even yet, found its way into common knowledge. Hence, the greater part of the voluminous literature on this subject, not only in medical publications but also in the advertisements of the thousands of purgatives, is founded on an entirely wrong conception of the fundamental mechanics. This vast literature has certainly made the public "bowel conscious," and I am convinced that if people would educate themselves to their natural bowel action, which may be anything from three times a day to twice a week, or even once a week, there would be infinitely less sickness. Bullying the bowels by purgatives into a routine that is contrary to the requirements of the particular individual is the cause of many troubles and many bowel conscious hypochondriacs.

I have tried to skim over a very large field in a short time, but I think I have said enough to convince you that the study of the mechanics is of at least equal importance to that of the chemistry of digestion. Incidentally, chemistry and mechanics are to some extent interchangeable, as a deficiency of active juices may be compensated for by increased movement, and vice versa. But of even greater importance than either the chemistry or the mechanics is the realization of the fact that Nature not only made each man as an individual, but gave to that individual a number of forces with which to perform each function. The way in which the individual varies the application of these forces in order to achieve the same end makes it an impossibility to describe any function in terms of a definite picture. For us, as practising clinicians, the lesson is that we should forget the concept of a standard and study each patient as an individual—forget, for instance, that one bowel movement a day is a definite standard. True, it may be the standard for the average, but patients are individuals, and it may be that if the patient can only forget all the unhealthy advertisement literature, he may find health with a bowel action of only once in three or four days, while another finds his normal routine twice a day. If we are to serve our patients faithfully we must go back to the methods of the old family physician who "understood the patient's constitution." We must not be lured by the easy rule-of-thumb methods and quasi science (often based on animal experiments only) that presume to reduce the art of medicine to an exact science.

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# EXPERIMENTAL STUDIES ON GASTRIC PHYSIOLOGY IN MAN

## IV. THE INFLUENCE OF OSMOTIC PRESSURE CHANGES OF SALT AND SUGAR SOLUTIONS ON PYLORIC ACTION AND GASTRIC EMPTYING IN THE NORMAL AND OPERATED STOMACH

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IN OTHER reports, we have considered the rôle of the pylorus in gastric motility and the control of pyloric action by duodenal stimuli[8] (acids, alkalies, fats, milk and cream[3]). This report, based on roentgenographic studies, presents some brief notes on the influence of duodenal osmotic changes on gastric motility and on the action of the pylorus—the test substances being salt and sugar solutions of various osmotic tensions.

All subjects were normal so far as we could ascertain through careful examination. The gastric acid response was standardized through at least three examinations with the usual Ewald test meal. The subjects were all adequately conditioned for these roentgenologic studies by preliminary trials. The standard test meal consisted of 2 ounces of barium sulphate in tap water at or near body temperature. All test substances were added to this meal which was changed in no other respect. The substances whose action we desired to study in the duodenum were introduced directly through a duodenal tube, the tip of which was accurately located by roentgenoscopic control. The effect of these test solutions on gastric action was always determined with the standard water barium meal as the medium.

Twenty-four subjects were used for this investigation: 4 with achlorhydria, 3 with hyperchlorhydria, and 9 with a normal gastric acid response. Observations were also made on 6 patients with posterior gastroenterostomies and 2 with gastric resections of the Pólya type. A total of 212 roentgenologic studies was done in all.

Since, on the whole, the data of these studies have no special statistical value, we feel it is better to confine ourselves to a review of a few sample protocols.

EXPERIMENT IX

(*a*) An achlorhydric stomach emptied the standard water barium meal in thirty minutes, as an examination of the ink drawings of the roentgenograms (Fig. 1) will reveal.

(*b*) *A 10 per cent glucose barium meal* was almost emptied from the stomach in thirty minutes, but with a different intestinal pattern.

(*c*) *A 20 per cent glucose barium meal* was discharged more slowly than the water barium meal so that in thirty minutes, the time at which the water barium meal had been evacuated, a residue of 65 per cent was still visible in the stomach.

(*d*) *A 40 per cent glucose barium meal* was so evacuated as to leave a residue of 80 per cent in the stomach at the end of 30 minutes—a *marked retention* when compared with the standard water barium meal.

(*e*) *A 5 per cent sodium chloride barium meal* brought forth a gastric motor response like the 40 per cent glucose barium meal—the only apparent roentgenographic difference being in the small intestinal pattern.

It seems from these findings that the more hypertonic the test meal, the slower the evacuation from the stomach. To learn the extent of influence of these substances on duodenal stimulation only, the test substances were allowed to come directly into contact with the mucosa through a duodenal tube. The patient then drank the standard water barium meal and roentgenologic studies of its behavior were made.

In the same patient (Fig. 2) the ink drawings of the roentgenograms reveal the following:

EXPERIMENT IX B

(*a*) The standard water barium meal was emptied from the stomach in thirty minutes.

(*b*) With the duodenal tube in place, no change was noted in the length of time the stomach evacuated the water barium meal. (Numerous determinations of this fact were made on many patients and found never to vary appreciably.)

(*c*) *Normal saline solution* dripped at the rate of 80 drops per minute into the duodenum through the tube did not effect a change in the gastric evacuation time of the standard water barium meal.

(*d*) With ordinary *tap water dropped 80 drops per minute* into the duodenum, the water barium meal left the stomach more slowly than when the test solution was isotonic. Thus it appears that hypotonic are like hypertonic solutions in their effect on gastric motility when acting on the duodenal mucosa.

(*e*) With a *5 per cent solution of sodium chloride* dripped into the duodenum at the rate of 80 drops per minute, a *retention of 80 per cent* of the standard water barium meal was noted at the end of thirty minutes. This is in marked contrast to the evacuation time of the isotonic saline solution.

In another patient with a more than normal gastric acid response, examination of ink reproductions of the roentgenograms in Figure 3 reveals the following:

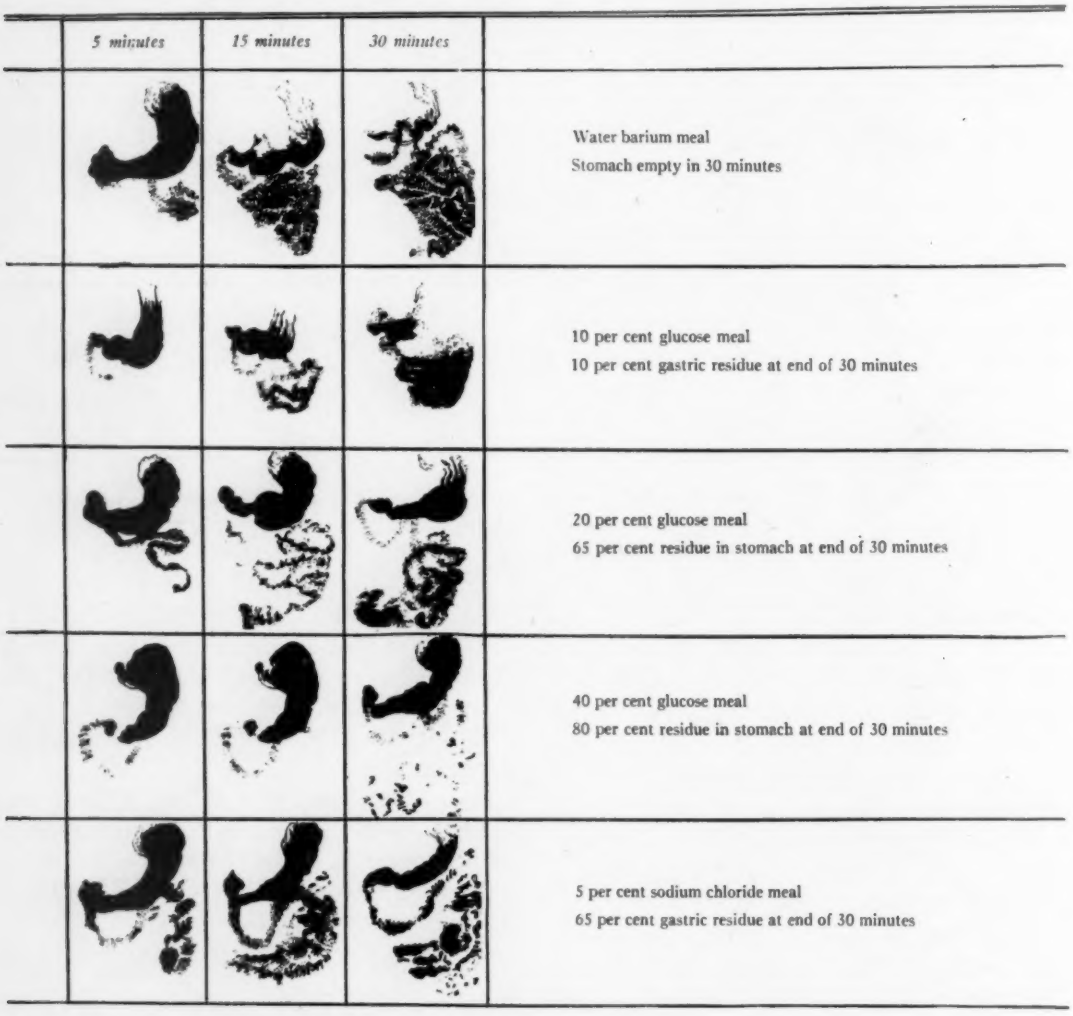
5 minutes
15 minutes
30 minutes
Water barium meal
Stomach empty in 30 minutes
10 per cent glucose meal
10 per cent gastric residue at end of 30 minutes
20 per cent glucose meal
65 per cent residue in stomach at end of 30 minutes
40 per cent glucose meal
80 per cent residue in stomach at end of 30 minutes
5 per cent sodium chloride meal
65 per cent gastric residue at end of 30 minutes

FIG. 1. The effect of hypertonic sugar and salt solutions on gastric emptying time.

EXPERIMENT IV

(*a*) The *standard water barium meal* was evacuated in ninety minutes.

(*b*) *A 1 per cent sodium bicarbonate barium meal*, an isotonic solution, left the stomach slightly faster than the water barium meal. This was to be expected because some neutralization of the intrinsic secretion of hydrochloric acid was effected.

(*c*) *A 5 per cent sodium bicarbonate barium meal*, a hypertonic solution, was evacuated with a marked delay—65 per cent gastric retention at the end of ninety minutes.

(*d*) When a *1 per cent sodium bicarbonate solution* was dripped 90 drops per minute into the duodenum, the gastric water barium meal was evacuated in ninety minutes, as the control water barium meal.

(*e*) With a *5 per cent sodium bicarbonate solution* dripped slowly into the duodenum at 50–60 drops per minute, the effect of this hypertonic solution was to delay markedly gastric evacuation: 75 per cent retention at the end of ninety minutes.

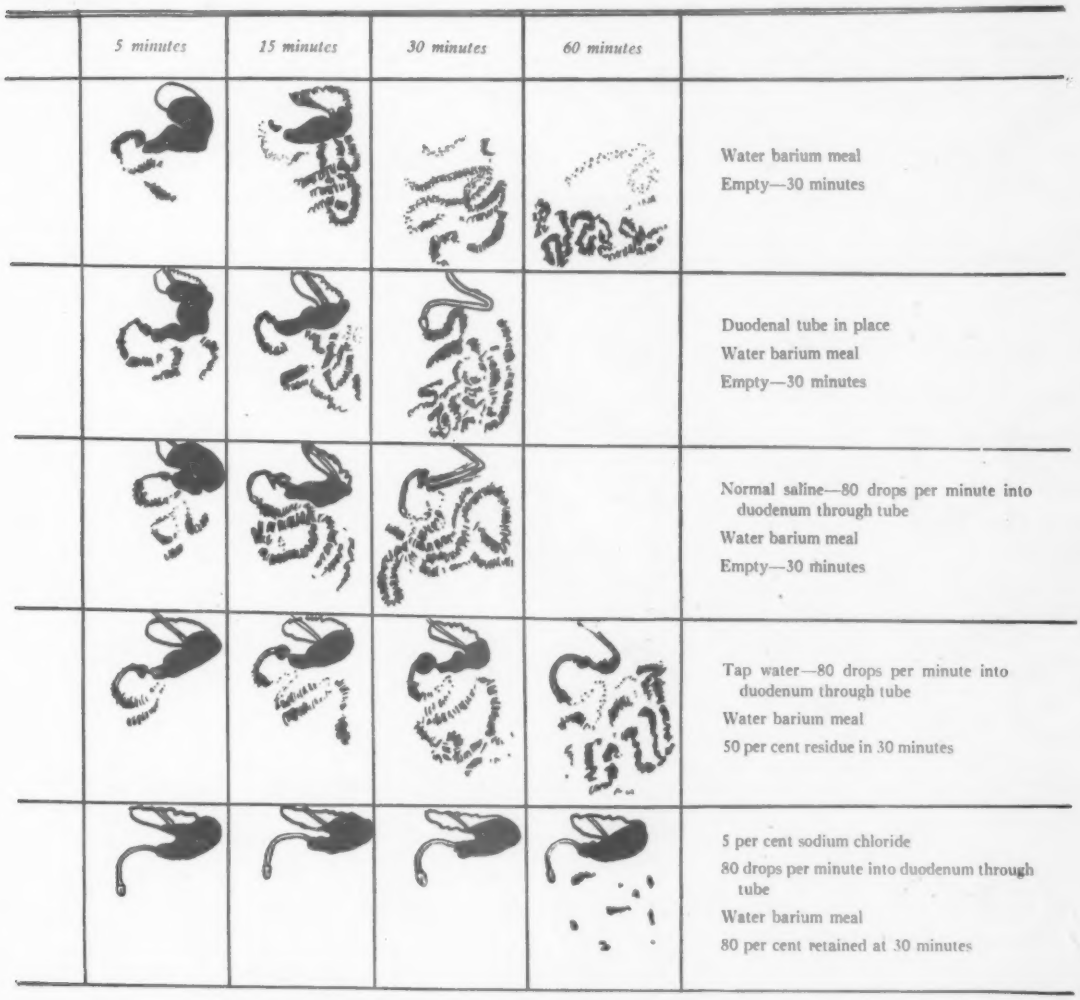
5 minutes
15 minutes
30 minutes
60 minutes
Water barium meal
Empty—30 minutes
Duodenal tube in place
Water barium meal
Empty—30 minutes
Normal saline—80 drops per minute into duodenum through tube
Water barium meal
Empty—30 minutes
Tap water—80 drops per minute into duodenum through tube
Water barium meal
50 per cent residue in 30 minutes
5 per cent sodium chloride
80 drops per minute into duodenum through tube
Water barium meal
80 per cent retained at 30 minutes

Fig. 2. The effect on gastric motility by osmotic changes in the duodenum of an achlorhydric as in Figure 1.

This again demonstrates the action of isotonic and hypertonic solutions, this time in a patient with a more than normal gastric acid response. The only differences present were due to the neutralizing action of sodium bicarbonate. Thus in a hyperchlorhydric patient, a 1 per cent sodium bicarbonate solution slightly increases the rapidity of gastric evacuation; and a

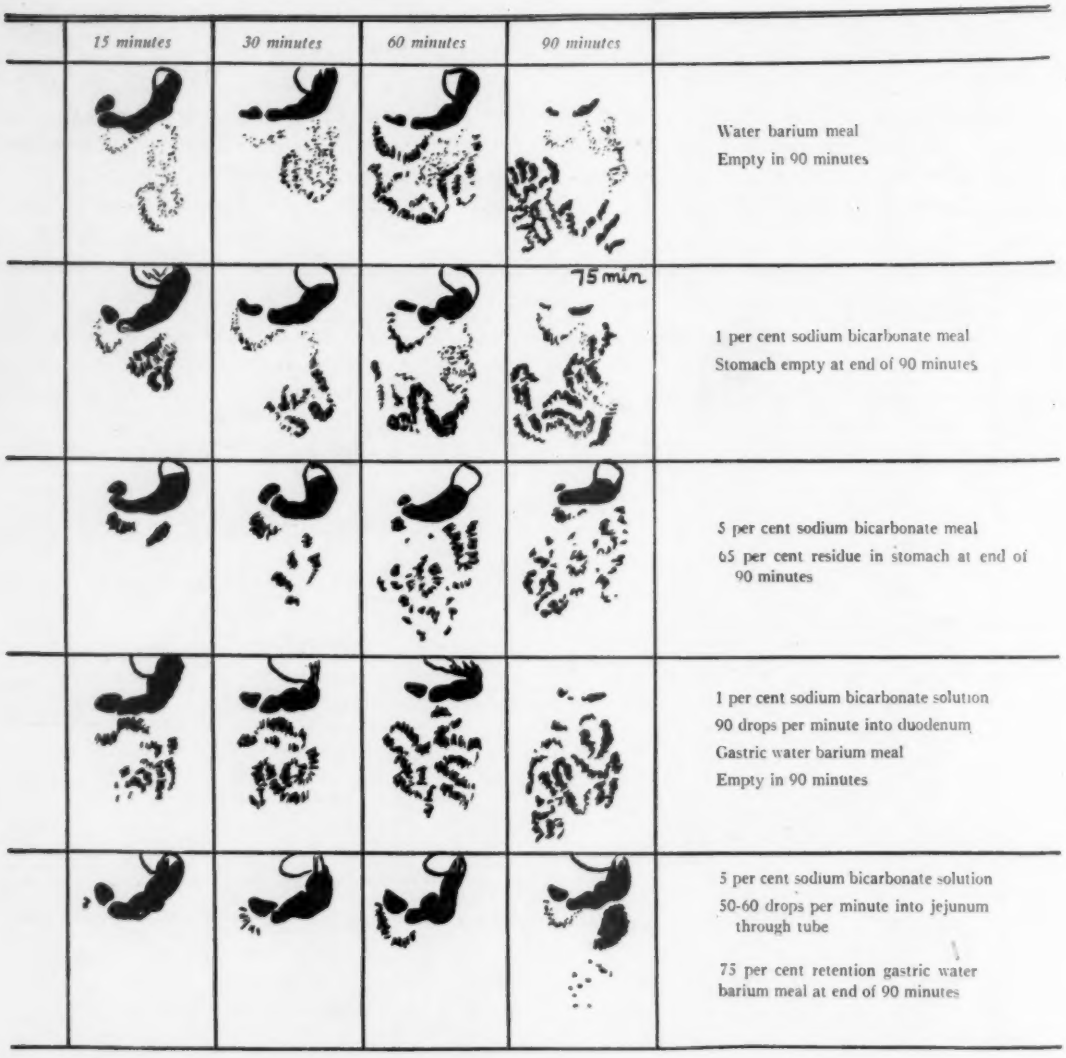
15 minutes
30 minutes
60 minutes
90 minutes
Water barium meal
Empty in 90 minutes
75 min
1 per cent sodium bicarbonate meal
Stomach empty at end of 90 minutes
5 per cent sodium bicarbonate meal
65 per cent residue in stomach at end of 90 minutes
1 per cent sodium bicarbonate solution
90 drops per minute into duodenum
Gastric water barium meal
Empty in 90 minutes
5 per cent sodium bicarbonate solution
50-60 drops per minute into jejunum through tube
75 per cent retention gastric water barium meal at end of 90 minutes

FIG. 3. The effect of sodium bicarbonate solutions in a hyperchlorhydric.

5 per cent sodium bicarbonate solution delays the evacuation of the standard water barium meal less than in an achlorhydric subject.[8] The effect is more marked when the test solutions are allowed to act directly on the duodenal mucous membrane.

In the operated stomach, either resected or with a posterior enterostomy, the effects of osmotic changes are essentially like those in the intact stomach, the only difference being quantitative (Figs. 4 and 5). At first glance, it may seem remarkable that artificial stomata in the operated stomach should act as the pylorus even if not so effectively. But there is no reason to regard the pylorus as other than a segment of specially developed gastric musculature. It differs in function from the general corporal musculature only because of its location and innervation. Once removed or shunted from normal use, its function can be performed by other segments of the stomach in a similar, albeit less effective, manner.

In our previous experiments, already reported, we were led to the conclusion that the hydrochloric acid, secreted by the stomach, was chiefly responsible for the

intrinsic control of pyloric action; and that pyloric action in turn was the most important factor in the mechanism controlling gastric emptying. Our findings supported Cannon's theory as it relates to the control of the pylorus by the acid and alkali secretions of the stomach and duodenum. Not only do acid and alkali, as intrinsic factors, control pyloric action, but extrinsic substances like fats, oils, and proteins also have definite influences—factors not adequately covered by Cannon's theory. And our notes here on the effects of osmotic tension of foodstuffs are also not explained by his theory.

When a liquid meal ingested is isotonic, the gastric evacuation time is definitely shorter than when the meal is hypertonic; and the more hypertonic the solution, the more marked is the delay. Thus solutions like 40 per cent glucose, 5 per cent sodium chloride, or 5 per cent sodium bicarbonate, all hypertonic, are retained in the stomach much longer than isotonic solutions. If these same test solutions are allowed to act directly on the duodenal mucosa without

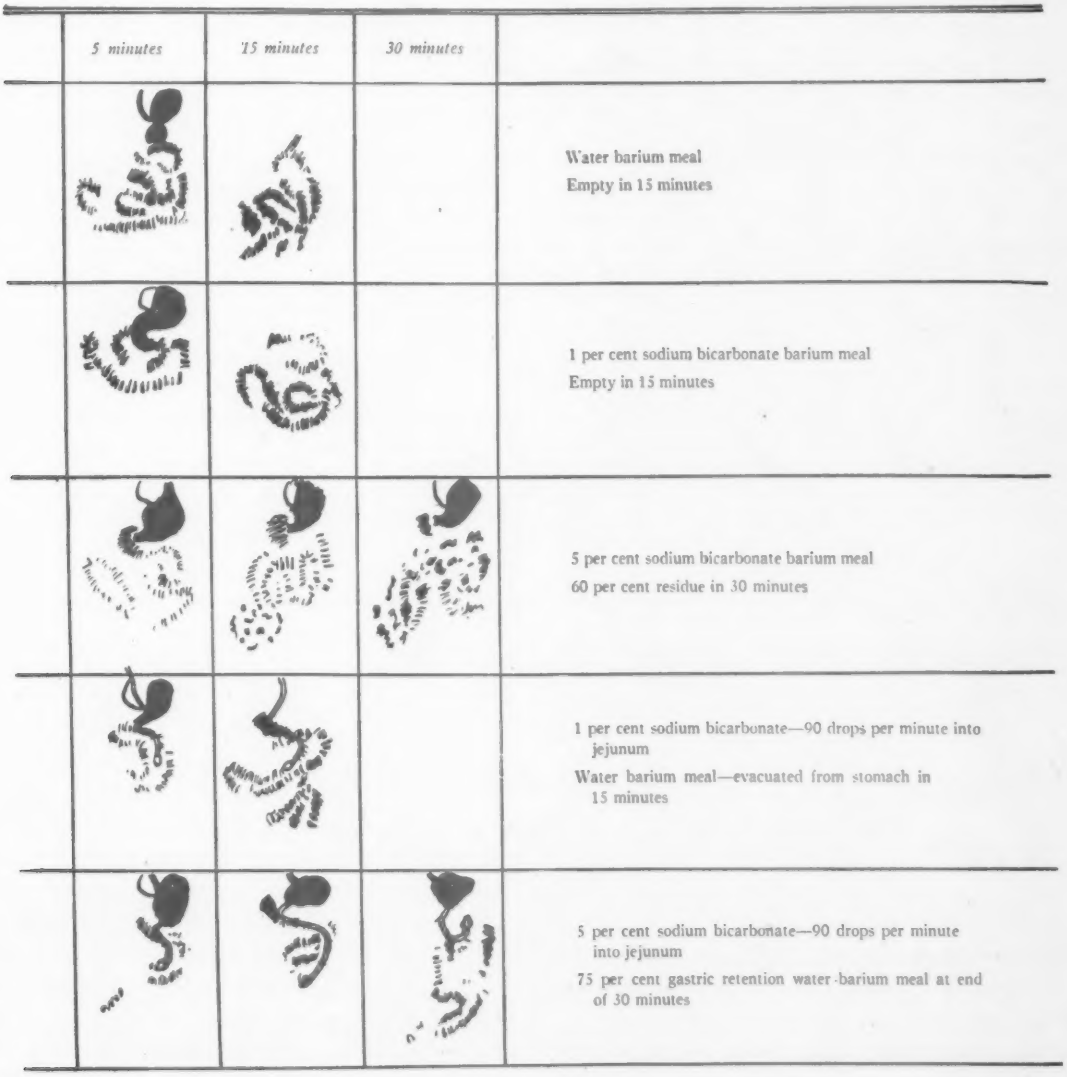
5 minutes
15 minutes
30 minutes
Water barium meal
Empty in 15 minutes
1 per cent sodium bicarbonate barium meal
Empty in 15 minutes
5 per cent sodium bicarbonate barium meal
60 per cent residue in 30 minutes
1 per cent sodium bicarbonate—90 drops per minute into jejunum
Water barium meal—evacuated from stomach in 15 minutes
5 per cent sodium bicarbonate—90 drops per minute into jejunum
75 per cent gastric retention water-barium meal at end of 30 minutes

Fig. 4. A resected stomach. The effect on motility by changes in osmotic tension of solutions in stomach and jejunum.

first coming into contact with the stomach, they slow gastric emptying more effectively. The difference in osmotic tensions of tap water and normal saline solution is not sufficiently great to produce an appreciable change in emptying times when these solutions are taken by mouth, but but to a progressively decreasing degree. This was confirmed by experiments of Johnston and Ravdin,[4] and Cerqua.[2]

McSwiney and Spurrell,[6] in spite of the fact that they used milk as the medium for their test meals, made similar observations. We have indicated how the

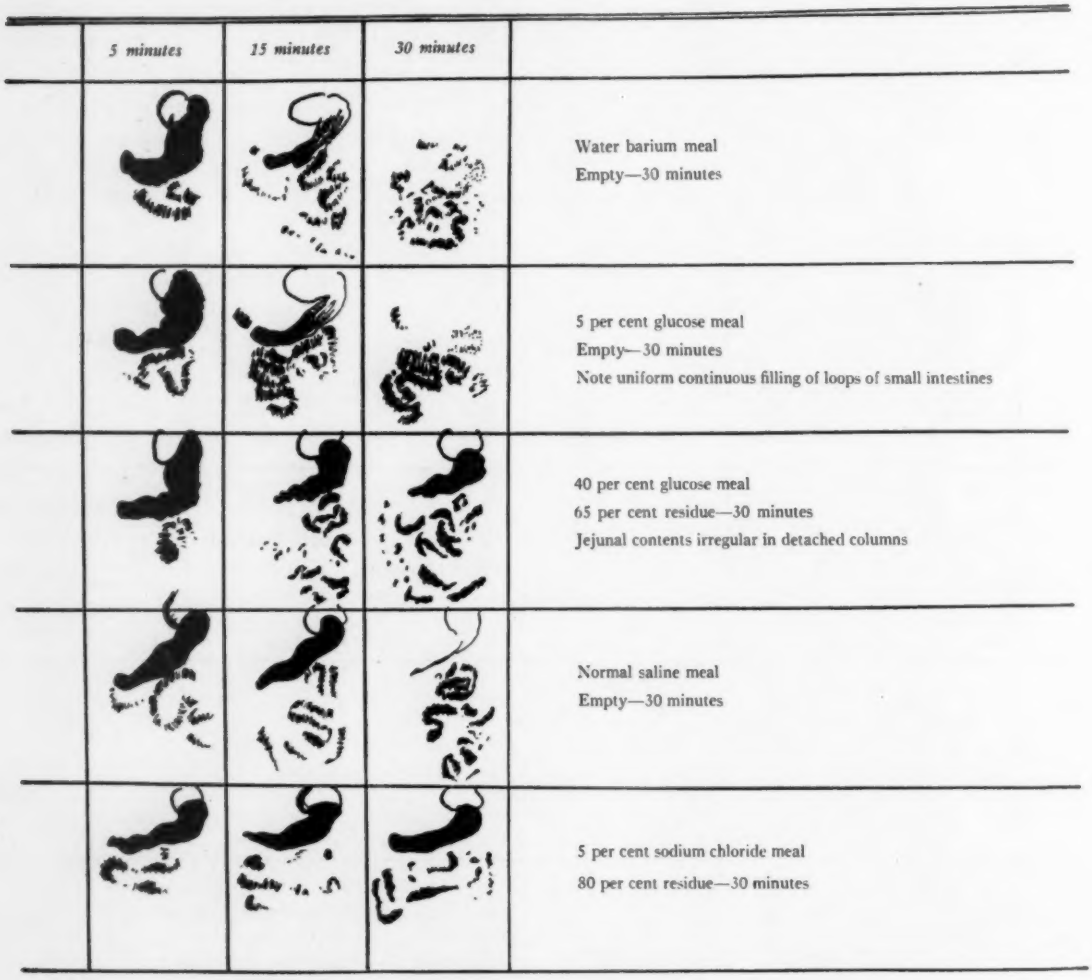


FIG. 5. A posterior gastroenterostomy. Effect of osmotic changes in stomach and jejunum on gastric motility.

the difference is marked when these solutions are allowed to come into direct contact with the duodenum (Fig. 2, C and D), where this is demonstrated by the ink reproductions of the roentgenographic gastrointestinal patterns. The jejunum and ileum, too, share with the duodenum the capacity of activation by test substances, concentration of fat in milk is in itself a modifying factor in gastric emptying;[3] nevertheless, these investigators were able to show that relatively small changes in the salt or sugar concentrations of their milk meals definitely altered gastric motility. They showed a direct proportional relationship between the osmotic pressure of

the test meal and gastric motility. When they added salt to a 350 cc. milk meal sufficient to alter the Δ of the milk meal from 0.55° to 0.91°C., gastric emptying time increased from three to almost five hours.

Since it takes only 2 grams of sodium chloride to a 350 cc. milk meal to change the Δ from 0.55° to 0.91°C., and since this amount of salt is not much more than is commonly used in culinary practice, the effect on the change of gastric emptying time by ordinary seasoning of foodstuffs can be readily appreciated.

Auchinachie, Macleod and Magee[1] have shown that the optimal concentration of glucose in 3M/4 for diffusion through surviving segments of mammalian intestine. In later experiments, Macleod, Magee and Purves[5] showed that in rats fed 1–2 cc. 3M glucose solution (54 per cent) marked dilution occurred in the stomach which usually ended when the concentration reached 13.4 per cent. This was associated with retardation of emptying. On the other hand, they found that there was practically no dilution when 4–7 cc. of M/5 glucose solution (3.6 per cent) was put into the stomach and that gastric evacuation time was reduced. While 4–7 cc. of M/5 glucose in the stomach may have given them the impression that glucose solutions at this lowered concentration hastened motility, similar observations made by us, but with larger quantities, would not seem to bear this out. The ingestion of hypotonic solutions is rapidly followed by a shift towards isotonicity through an increase of salt content of the gastric secretion, even in the achlorhydric. It is this rapid adjustment of tonicity that makes motility seem hastened if the quantity of test solution is too small. Only if the quantity is great enough materially to increase the time of adjustment of osmotic tension can one overcome the experimental error incident to motor observations with small hypotonic solutions; and there is no question in our mind that water, as a hypotonic solution, more definitely activated pyloric closure and gastric retention when applied directly to the duodenal mucosa than did normal saline solution under similar test conditions.

Another interesting observation of Macleod, Magee, and Purves was "that a low sugar concentration, and perhaps a low osmotic pressure, on the stomach side tend to promote inhibition of the pyloric sphincter. Rapidly recurring gushes or continuous discharge of sugar solutions from the stomach would give rise to fairly constant sugar levels in the intestine, which we have found to be the case when weak sugar solutions are fed (M/5). When on the other hand strong solutions, 3M, were used, the intestinal sugar varied from 0 to 11.4 per cent. These fluctuations suggest that the gastric fluid was only admitted into the intestine at intervals between which the sugar in the ejected fluid was fairly completely absorbed." The more concentrated the sugar solution we used, the more interrupted became the emptying of the stomach and the greater the intervals between spurts of the gastric contents into the duodenum. No wonder, then, that this should strikingly change intestinal patterns, and excite interest in this subject by such able workers as Ravdin, Pendergrass, Johnston and Hodes.[7] They, particularly, showed how sensitive is the response of gastric emptying to duodenal stimulation with concentrated sugar and oil solutions, even in the operated stomach. Their observations dispel the concept of posterior gastroenterostomy and gastric resection as dumping operations if the meal is hypertonic; and they pointed out, also, that intestinal patterns change with each alteration in the concentration of the meal. Our findings suggest a simple explanation for these phenomena.

It seems that when there is an abnormal osmotic tension of a solution on the duodenal side of the pylorus, the pylorus contracts. Adjustments of abnormal osmotic tensions are more rapid in the duodenum than in the stomach. This may be true because it receives relatively small quantities of fluid and also because the mecha-

nisms of diffusion and neutralization are more efficient. Therefore, very little time elapses after the head of a column of a hypertonic solution enters the duodenum, before osmotic tension in the duodenum approaches isotonicity. The stimulus in the duodenum that called forth contraction of the pylorus then subsides, the pylorus opens, the hypertonic solution again enters and stimulates the duodenum, the pylorus closes and the chain of readjustments of the osmotic tensions of the duodenal solution repeats itself. Between successive openings of the pylorus, a fall in the osmotic tension of the gastric solution takes place due to diffusion which also occurs in this organ, but not with the same rapidity as in the duodenum. Thus when a few cubic centimeters of a 40 per cent sugar solution passes through the pylorus after the head of the column has progressed through the stomach, the pylorus closes immediately; this closure is maintained not until all the gastric, but only until the duodenal contents approaches isotonicity; and this takes place within a relatively short time. In a few minutes, another spurt of gastric contents is ejected from the pylorus which again closes and remains closed until the duodenal tension of the solution reaches isotonicity. Then the sequence is repeated, but the intervals become shorter since gastric dilution is simultaneously taking place. With each successive spurt from the stomach, the ejecta are less hypertonic. This decreases the difference in osmotic tension between the solutions bathing the gastric and duodenal sides of the pylorus which opens and closes more frequently, tending more and more towards the end of the experiment to remain constantly open as the osmotic tension of the gastric contents reaches isotonicity. The intestinal pattern is thus definitely modified by the manner in which the stomach empties, so that osmotic tension of a meal is an important factor to be considered when intestinal patterns are studied.

It now becmes possible logically to interpret some of the factors in the control of pyloric action in the absence of hydrochloric acid, as in the achlorhydric. In these cases, the extrinsic factors inherent in the various foodstuffs, with the added condiments, can, and do, substitute for the intrinsic factors, especially the gastric hydrochloric acid. Could it be that the sensitivity of response is not so great in the achlorhydrics where this regulation depends much more on these extrinsic factors than in the normal or hyperchlorhydric where the intrinsic factors are in full operation? With meals whose osmotic pressure does not excite pyloric action, gastric evacuation is rapid and this phenomenon is very familiar to the roentgenologist. He habitually sees rapid evacuation of gastric meals in the achlorhydric. But if the test meal is changed to one in which salts are present—even in the small quantities used for seasoning—although the osmotic tension is changed very little, it is sufficient to cause a different pyloric action. This effect is operative not only on the intact pylorus, but also on the gastric musculature about an artificial stoma. Ravdin, Pendergrass, Johnston and Hodes[7] have also shown that gastric evacuation is not passive in the operated stomach and that it becomes more and more intermittent and regulated as the concentration of sugar rises in the test meals. Thus consideration of the osmotic tension of a test meal may be an important factor in the regulation of pyloric action and gastric emptying and where Cannon's theory failed to explain pyloric action in the achlorhydric, our findings help; but it must not be forgotten that the factor of osmotic tension is only one of several that play a part in this mechanism. Some of these factors we have touched upon in previous papers; others are yet to be analyzed and reported.

## SUMMARY

In a series of experiments in man, the effect of osmotic tension of test meals on gastric emptying was studied. The response of the pylorus and its action in controlling

gastric evacuation were examined and compared with the action of the gastric musculature about the stoma of the operated stomach. Our observations lead us to believe that osmotic pressures above or below isotonicity definitely influence pyloric action and gastric evacuation and that the greater the hypertonicity of the test meal, the slower is gastric emptying. This also holds for the operated stomach, but not to the same degree as in the intact stomach. This factor of osmotic tension is only one of several extrinsic factors inherent in foodstuffs which modify gastric emptying, both in time and rhythm, thus conditioning the roentgenologic appearance of intestinal patterns. And finally, Cannon's theory of pyloric action, which fails adequately to explain roentgen observations of gastric emptying in the achlorhydric, is made tenable if the response of the pylorus to osmotic changes in the test meal is regarded as one of the factors that may be operative in the normal function of the pylorus.

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# GIANT CELL TUMOR OF THE VERTEBRAE*

## REPORT OF TWO CASES

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GIANT cell tumor of a vertebra is a diagnostic problem which occurs with sufficient rarity to merit the report of 2 cases. These cases came under observation within seven months of each other and the tissue diagnosis in each was issued from a pathology department which has had one other giant cell tumor of the vertebra in the experience of Dr. Edwin F. Hirsch—a period of approximately fifteen years.

A cursory survey of the literature indicates that Lewis in 1924 collected 16 cases and added 1 of his own. In 1932, Kirklin stated that the average pathologist will not see more than 10 cases of osteogenic sarcoma during his own lifetime. He states further that the ratio of giant cell tumor to osteogenic sarcoma is less than one to five at the Mayo Clinic. Of the 110 cases of giant cell tumors studied by Kirklin, 2 were in the vertebrae. In Geschickter and Copeland's observation of over 250 cases of giant cell tumor, 8 were in the spine. Murphy, in 1935, reviewed the literature and gathered a total of 45 cases of giant cell tumor of the vertebrae.

The conception of giant cell tumor formation as an entity is not recent, and credit for recognition of the benign nature of the process is generally given to Nélaton (1860), although Paget at an earlier date had suggested the probable innocence of the lesion.

Gross, in 1879, based his conclusions concerning the clinical and pathological characteristics of "giant cell sarcoma" on 70 cases which had come under his personal observation. Gross quotes Billroth as stating: " 'The subdivisions, made according to the histological peculiarities of the various sarcomata, are of no great value during life.' "

One-half of the 70 cases studied by Gross had a history of traumatism. Gross states:

> Of the central, intraosseous, endosteal, or myelogenic sarcomas of the long bones, by far the most interesting, from their relative frequency, comparative benignity, and large size of the cells of which they are mainly composed, are those denominated myeloid tumour by Paget, myeloplaxic tumour by Eugène Nélaton, and giant-celled sarcoma by Virchow.
>
> Myeloid sarcoma is composed of a stroma of spindle and round cells, but particularly the former, in which the characteristic multinucleated elements are embedded, with the intervention, usually, of little, if any, visible intercellular substance.

Gross identified the giant cell with the osteoclast described by Kölliker, and stated that they were "very similar to those found normally in the medulla of growing bones at the point of contact of the marrow with the osseous tissue." He also stated that they were to be found in the cambium layer of the periosteum. Four-fifths of his cases occurred after the age of twenty. It was the belief of Gross that irritation (traumatic or otherwise) induced a reversion to a fetal state. A relationship to cyst formation was suggested; the predominant location was epiphyseal in the lower femur or upper tibia.

> During their entire progress, giant-celled sarcomas generally exhibit no tendency to break through their limiting capsules [partly membranous, partly bony], hence their influence on the surrounding tissues is almost purely mechanical, the overlying and associated structures being, as previously indicated, stretched and attenuated, and not incorporated with the tumour, or implicated by extension of the disease.

The malignancy of a few of these tumors was thought to be based on metamorphosis to central ossifying and calcifying sarcoma. The possibility of confusing giant cell areas in sarcomas with "giant cell sarcomas" is mentioned.

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The above work is cited at length because the age incidence, distribution, epiphyseal location, fundamental innocence, kinship to cyst formation and potential malignant metamorphosis correspond to recent views advanced by Geschickter and Copeland. The latter authors consider giant cell tumor formation to be the counterpart of a certain phase in normal bone development, extending beyond the boundary of normal because of exaggerated activity of osteoclasts. This exaggerated osteoclastic activity is designated "progressive osteoclasia" and is similar to the absorption of calcified cartilage in normal bone development. The initial stage in the evolution of the tumor is a disturbance in the cortical blood supply of an epiphysis. Often this arises from trauma. Stimulation of osteoclast formation follows, the function of which is to repair the area anticipatory to regeneration. The entrance of osteoclasts is followed by increased vascularity. The process occurs at an age when and at a site where bone repair is less active than along the diaphysis, and hence osteoclasia overbalances osteogenesis. A similar process occurring in the diaphyseal side of the epiphyseal line causes cyst formation, wherein osteogenesis overbalances osteoclasia, "regressive osteoclasia." An early healing response in small bones, manifested by the marked production of spindle cells, is noted by Geschickter and Copeland. Pertinent to this is the observation of Lewis that there is a tendency toward early calcification and re-ossification in giant cell tumor of the spine.

From a diagnostic standpoint, the first case, the description of which follows, illustrates Kirklin's observation that one-half of his cases of giant cell tumor lack the characteristic trabeculation and instead exhibit a homogeneous lysis with a preservation of only a portion or none of the cortex. The tumor in these cases has approximately the same density to radiation as other soft tissues and the roentgenograms give evidence of a hazy, homogeneous mass filling the space occupied by dissolved bone, frequently extending considerably beyond the cortical surface and pushing the soft tissues ahead of it. This first case is unique in the manner in which this homogeneous mass simulated a paravertebral abscess (Figs. 1 and 2).

Case 1. A female, white, aged eleven, was admitted to the hospital May 20, 1936, on the

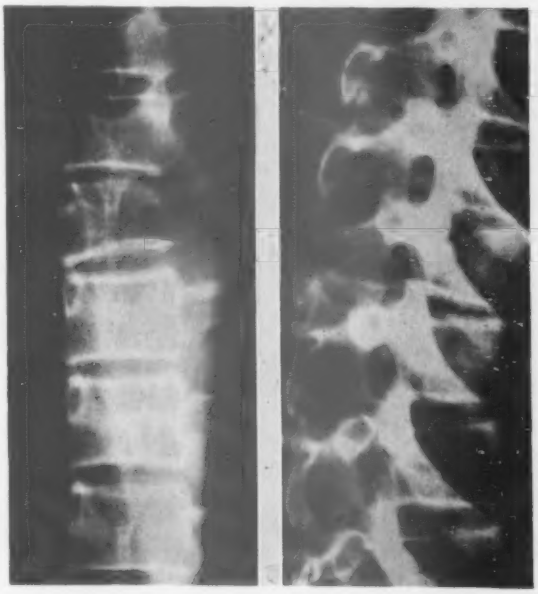

Fig. 1. Case 1.



Fig. 2. Case 1.

Orthopedic Service of Dr. Edwin W. Ryerson with the essential complaint of dorsal backache of approximately two months' duration. Two weeks earlier the patient had been brought to the pediatrics' outpatient department by her mother because of pain in the region of the left scapula, especially at night. Pain in the left costal arch, especially after exercise, was an additional complaint at the time of this first visit. On return to the dispensary one week later, pain was also complained of in the mid-dorsal region just to the left of the spine. The mother of the patient stated that the latter awakened at night with this pain. At this time the von Pirquet test was negative.

A roentgenogram taken May 13, 1936 (Figs. 1 and 2), indicated a destructive process involving the body of the fifth dorsal vertebra with slight compression of the body on the left side and a homogeneous left paravertebral shadow which resembled an abscess. The articular spaces were not conspicuously invaded.

On May 20, 1936, the patient was seen again in the dispensary, from where she was admitted to the hospital. By this time, tapping the back in the region of the spine of the sixth dorsal vertebra caused pain and there was also definite tenderness to the left of this area. A pillow placed under the patient's shoulders relieved

FIG. 3. Case I.

FIG. 4. Case I.

the pain. The patient had no symptoms referable to other systems. Her health had been excellent and her past history was entirely negative. The patient's father died of tuberculosis. The only physical finding at the time of admission to the hospital was tenderness in the neighborhood of the sixth dorsal vertebra. There was no clinical deformity. Muscle spasm was present in the dorsal region. She was afebrile and routine blood and urine studies were within normal limits. The blood Wassermann and Mantoux tests were negative.

On May 28, the patient was taken to surgery. Marked necrosis and gray tumor tissue infiltration of the left lamina, transverse process, and pedicle of the fifth dorsal vertebra were present. The periosteum was destroyed. There was infiltration of the soft tissue structures but essentially there was replacement of bony tissue. A modified Hibbs' fusion of the third, fourth, fifth, sixth, seventh, and eighth dorsal vertebrae was done.

The histological examination by Dr. Edwin F. Hirsch of the tissue removed at operation indicated the presence of a "so-called myeloid giant cell sarcoma of a thoracic vertebra."

The patient's postoperative course was uneventful. She was immobilized on a Bradford frame, all of the time at first, later only at night, and was discharged from the hospital December 9, 1936. At the present time, January 15, 1937, she is without complaint and engaging in ordinary childhood activity, although not yet going to school.

Roentgenologically, there is definite improvement July 15, 1936, with evidence of reossification and increased density of the affected vertebra. The paravertebral shadow has disappeared. On October 16, 1936, further improvement is noted, and January 15, 1937, the roentgenograms (Figs. 3 and 4) verify the improved clinical status of the patient.

The patient has had a total of 3,300 r using 200 kv. (peak), with one portal of entry, 20-inch distance, 0.75 mm. Cu and 1 mm. Al. This irradiation has been given in eighteen treatments divided into five courses, each approximately one month apart.

CASE II. Female, white, aged twenty-two, admitted to the hospital December 4, 1936, as

FIG. 5. Case II.

FIG. 6. Case II.

a private patient of Dr. F. A. Chandler, with a complete paraplegia, absence of sensation below the umbilicus and "cord bladder." Paraplegia had developed over a period of three days, the initial event having been a severe lumbar pain noted when the patient lifted her baby. There was also history of pain in the back with radiation to both costal margins

which began eighteen months prior to admission, during pregnancy.

Roentgenological examination (Figs. 5 and 6), December 5, 1936, disclosed the presence of a destructive process involving the body and appendages of the eleventh dorsal vertebra with compression, kyphos, and preservation of the integrity of the interarticular spaces above and below the body of the affected vertebra.

At surgery December 5, 1936, a yellowish, avascular material was found in the region of the right lamina of the eleventh dorsal vertebra and the right lamina itself was friable and necrotic. The spinal cord was angulated at the level of the kyphos but pulsated slightly. There were no dural tears. After removal of the laminae of the tenth, eleventh, and twelfth dorsal vertebrae, cord pulsation was definite. A rib graft was placed along the left transverse processes of the above-mentioned vertebrae.

Tissue removed at operation was examined by Dr. Hirsch: "*So-called myeloid giant cell sarcoma of the eleventh thoracic vertebra.* These portions have a fibroblastic stroma with many multinucleated giant cells, other large mononuclear cells, and a few lymphocytes. With these tissues recognized, it is possible to trace in the necrotic portion a similar tissue pattern. In this are many unusually large myeloid cells. Some portions of the sections have necrotic tissues continuous with some cellular organizing chronic granulation tissues" (Fig. 7).

Convalescence was uneventful. The patient received one course of roentgen therapy of 960 r, using 20-inch distance, 0.75 mm. Cu, 1 mm. Al, and 200 kv. (peak), 160 r being given daily. On discharge from the hospital on January 14, 1937, there was slight sensory improvement but no appreciable change in the paralysis. Further roentgen therapy is contemplated.

Fig. 7. Case 11.

## SUMMARY

Two cases of an unusual lesion, giant cell tumor of the vertebra, which offered diagnostic difficulties, are presented. This condition is worthy of consideration in any osteolytic process involving a single vertebra, and the elimination of metastatic carcinoma, tuberculosis, Hodgkin's disease, leukemia, and osteogenic sarcoma is requisite to diagnosis.

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# VENTRICULOGRAPHIC LOCALIZATION OF INTRACRANIAL TUMORS

## II. TUMORS OF THE AQUEDUCT, PONS AND CEREBELLO-PONTINE ANGLE*

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IN A PREVIOUS communication,[1] the characteristic ventriculographic signs produced by tumors arising immediately adjacent to the posterior aspect of the third ventricle have been enumerated and discussed, and the surgical and roentgenographic procedures essential to the production of satisfactory ventriculograms have been outlined.

Tumors situated in the posterior fossa of the skull, frequently classified in the subtentorial group, are responsible for an array of roentgenological signs by which their location and approximate size may be recognized. The nature and degree of these signs vary throughout a wide range, entirely in keeping with the multiplicity of anatomical structures which may be involved directly or indirectly by tumors arising beneath the tentorium. It has already been pointed out that certain characteristic changes in the roentgenographic appearance of the gas-filled third ventricle are virtually pathognomonic of tumors arising in that immediate vicinity. Such tumors seldom produce recognizable changes in the course of the aqueduct or the position of the fourth ventricle since they almost always produce early obstruction of the aqueduct at the point of its communication with the third ventricle, thus preventing pneumatization beyond this point. Tumors in the subtentorial group may, and often do, modify the appearance of the third ventricle but the changes in ventriculographic appearance primarily characteristic of these tumors concern the aqueduct and the fourth ventricle.

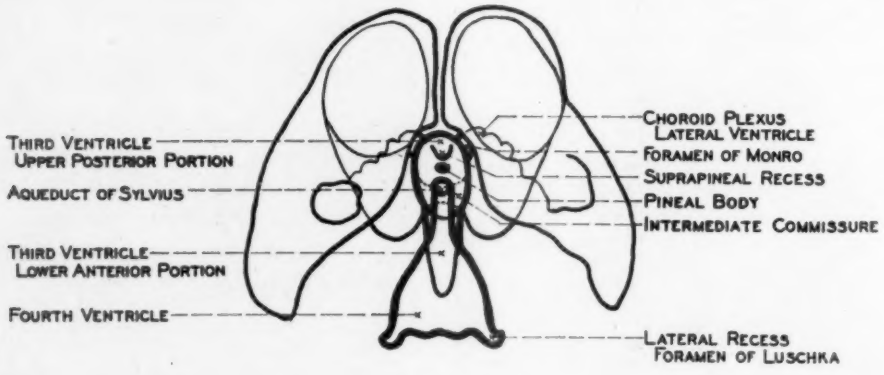



FIG. 1

As in the case of tumors situated more anteriorly, neoplasms arising in or near the pons almost without exception produce sufficient narrowing of the aqueduct to, in turn, produce some degree of internal hydrocephalus. The extent of generalized dilatation of the ventricular system is less marked in the case of intrapontine tumors than in the case of other tumors located close to the anterior end of the aqueduct.

In the posterior sagittal view of the dilated ventricular system (Fig. 1), the beginning of the aqueduct is projected

* From the Department of Roentgenology and the Department of Surgery, Service of Dr. Max M. Peet, University of Michigan, Ann Arbor, Michigan.

upon the superior, posterior part of the third ventricle. It is seen as a small, round area of increased translucency. The aqueduct continues downward in the midline as a gas-filled streak, partially overlapping and the fourth ventricle, although they also modify the appearance of the third ventricle. In the case of those cerebellopontine angle neoplasms which extend sufficiently far anteriorly, displacement and

Fig. 2

the anterior, inferior portion of the third ventricle and widening below into the triangular fourth ventricle.

In the lateral view (Fig. 2) the aqueduct is visualized as a narrow channel curving backward and downward from the posterior, inferior margin of the third ventricle. Its lower part broadens gradually into the triangular fourth ventricle. The anterior border of this ventricle, corresponding to the floor of the rhomboid fossa, normally joins the aqueduct with a smooth curve.

Deformities of the ventricular system produced by tumors arising in the vicinity of the pons concern primarily the aqueduct compression of the temporal horn on the affected side may occur. These characteristic anatomical changes are illustrated schematically by Figures 3 and 4.

Figure 3*A* represents a midline vertical section through the brain stem and the cerebellum. The cross-hatched portion represents a pontine tumor which is displacing the aqueduct and the fourth ventricle upward. The posterior portion of the third ventricle is also upwardly displaced.

Fig. 3, *A* and *B*.

Figure 3*B* indicates schematically how this same tumor would appear on the cut surface of a section made through the pons and cerebellum at right angles to the long

axis of the brain stem. In this view one can recognize the slightly off-center position of the tumor producing asymmetrical flattening and upward displacement of the fourth ventricle.

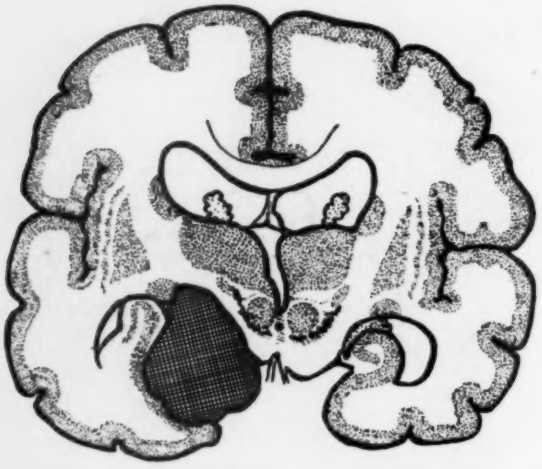


FIG. 4

Figure 4 represents schematically a transverse section of the brain at the level of the red nucleus near the anterior margin of the pons. The cross-hatched area indicates an unusual cerebellopontine angle tumor which has extended forward into the middle fossa beneath the temporal lobe, producing lateral displacement of the posterior portion of the third ventricle, as well as some displacement and compression of the temporal horn of the lateral ventricle.

From the case records of some 400 brain tumors diagnosed and subjected to roentgenological examination in this clinic during the past six years, the ventriculographic evidence of tumor site has been reproduced in 6 instances to illustrate the major findings characteristic of tumors of this group. These 6 examples have been selected because in each case the exact anatomical location, the true size, and the pathological type have been definitely proved at operation or at autopsy.

### TUMORS OF THE AQUEDUCT

True aqueduct tumors are exceedingly rare. They arise in the gray matter immediately surrounding the aqueduct and because of their position characteristically obstruct this channel completely, even though they may be too small to affect other brain structures directly. The only ventriculographic sign to indicate the existence of a tumor of this sort consists of severe generalized hydrocephalus involving all structures anterior to the point of aqueduct obstruction. It is well to remember that equally effective blockage of the aqueduct can be produced by a variety of more distant subtentorial tumors and that

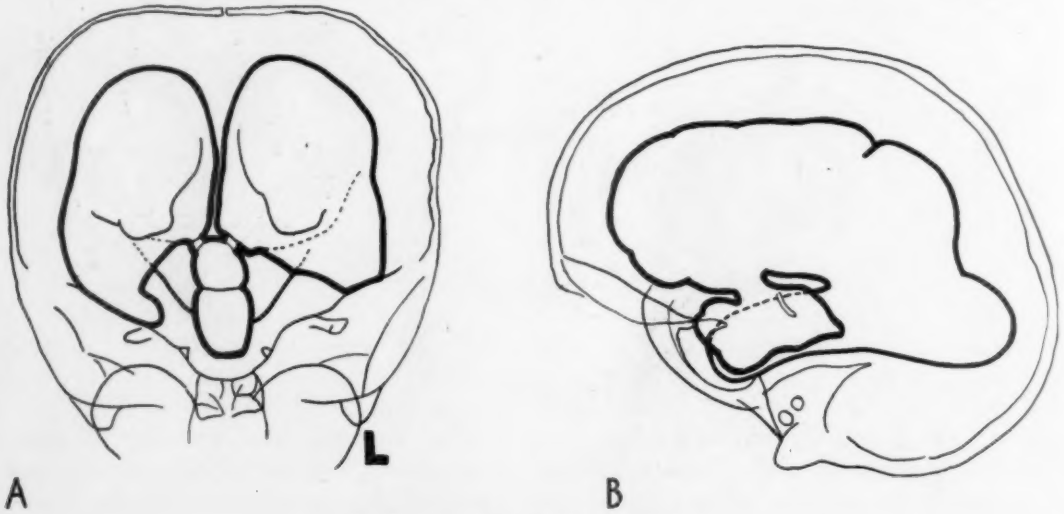



FIG. 5, *A* and *B*. Case 1 (354555).

from the ventriculogram alone, one may be unable to recognize any differential sign. Case I is an example of this situation. Line drawings taken directly from original ventriculograms in sagittal projection with the occiput superior and in right lateral projection (Figs. 5*A* and *B*) show tremendous dilatation of the lateral and third ventricles with no gas filling of the aqueduct. It is noteworthy that the posterior, inferior portion of the third ventricle is overlapped by the temporal horn, indicating that there has been no upward displacement of the third ventricle. As seen in the sagittal projection, there is no recognizable shift of midline structures to either side.

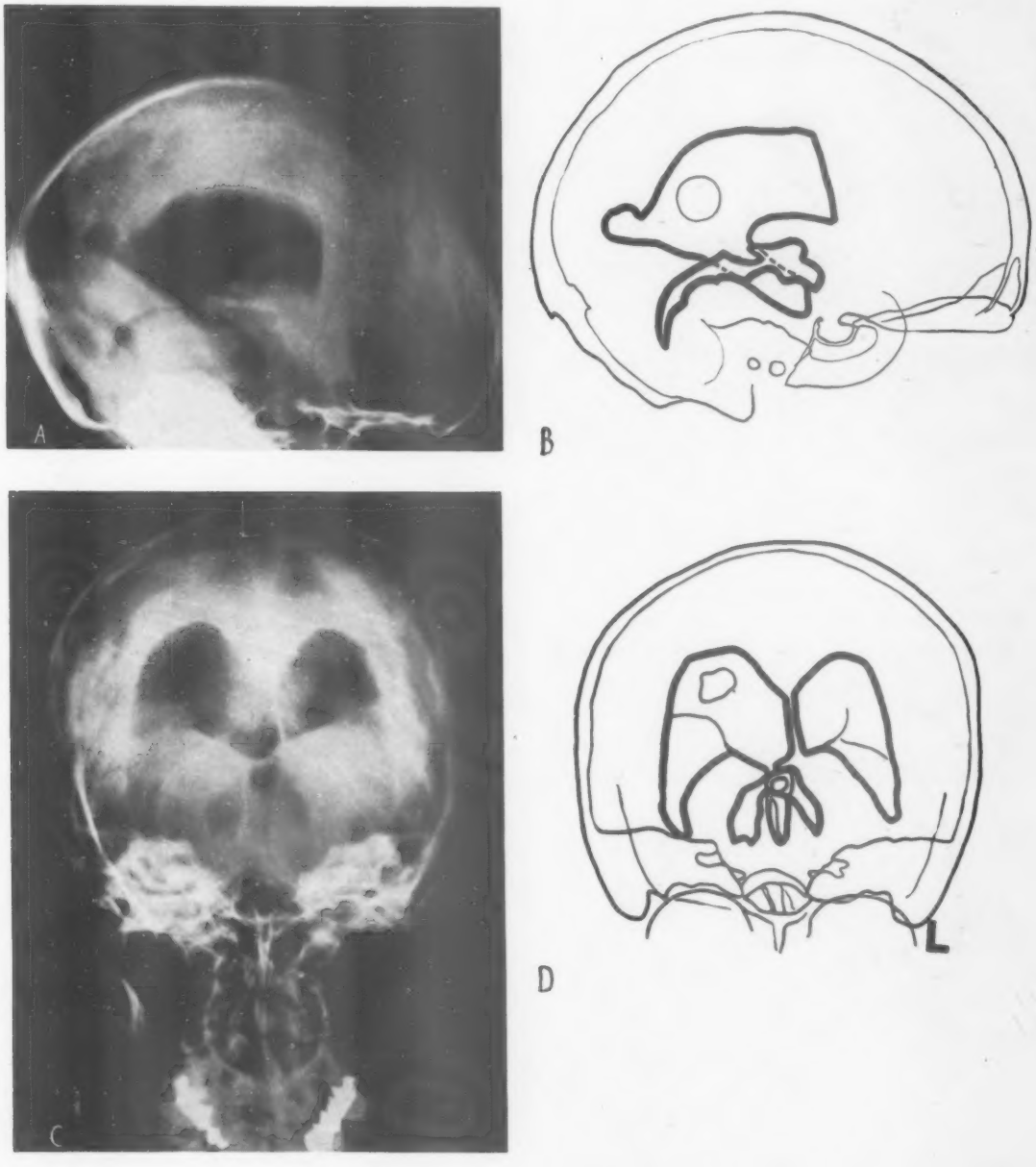
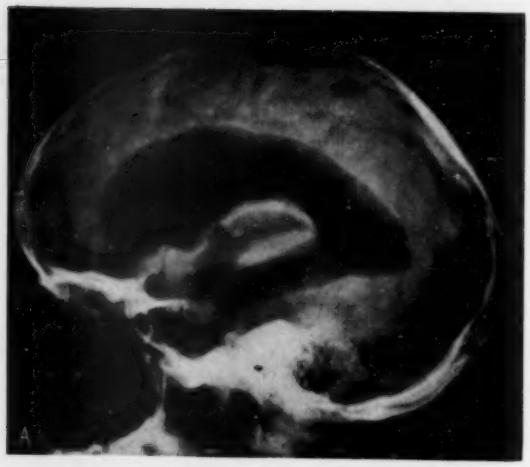
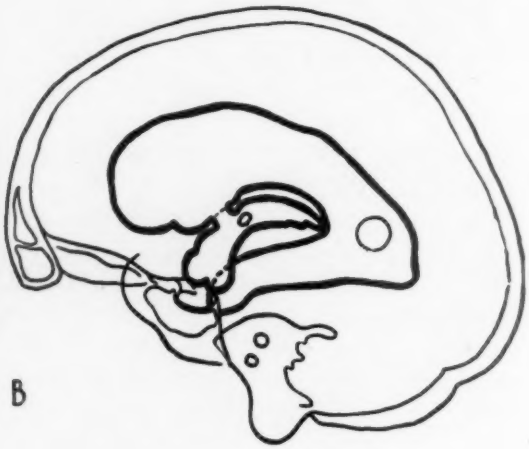
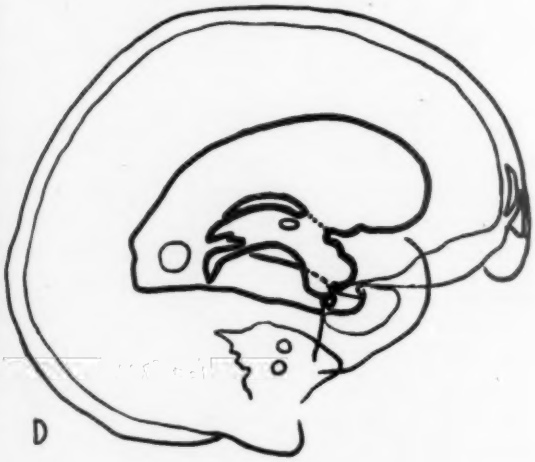



Fig. 6, *A*, *B*, *C* and *D*. Case II (378619).





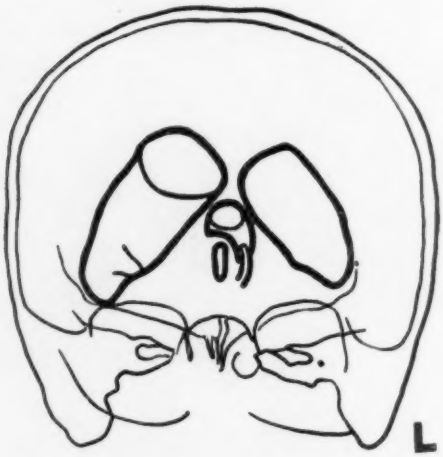



FIG. 7, *A*, *B*, *C*, *D*, *E* and *F*.
Case III (196583).

### INTRAPONTINE TUMORS

The accurate diagnosis of pontine tumors can usually be made by neurological examination alone, and when these tumors are small, ventriculograms add little information. If, however, an intrapontine tumor attains sufficient size, it will produce more or less marked hydrocephalus and certain characteristic local deformities. The aqueduct and fourth ventricle are displaced upward and posteriorly, increasing the distance between the clivus and the aqueduct and fourth ventricle (see Figs. 3*A* and *B*).

Case II illustrates a midline pontine astrocytoma. In lateral view, with the occiput superior (Figs. 6*A* and *B*), upward displacement of the aqueduct and fourth ventricle is obvious. Oxygen in these structures is seen outlining the nodular superior margin of the tumor. The sagittal view (Figs. 6*C* and *D*) shows the fourth ventricle displaced neither to right nor left, but deeply indented by the tumor along its anterior wall.

If instead of occupying a midline position, a tumor of the pons originates to one side, the aqueduct and fourth ventricle will show displacement in the opposite direction. If the brain stem is displaced anteriorly and upward through the incisura tentorii by indirect tumor pressure, or if the neoplasm actually invades the anterior part of the mid brain, a filling defect involving the inferior margin of the third ventricle may be apparent.

Case III, a pontine astrocytoma to the right of the midline which extends into the cerebellopontine angle on this side, illustrates these ventriculographic signs of lateralization.

Figs. 7*A* and *B*, representing the original right lateral ventriculogram and a line drawing derived from this roentgenogram, show elevation of the floor of the third ventricle in its posterior portion to a greater extent than is apparent when one examines the left lateral projection (Figs. 7*C* and *D*). This finding itself indicates the right-sided position of the tumor as well as its situation beneath the third ventricle. Figures 7*E* and *F*, representing direct reproduction of the original sagittal view, occiput superior,* and a line tracing of the roentgenogram, show upward displacement and local indentation of the floor of the posterior portion of the third ventricle from the right as well as displacement of

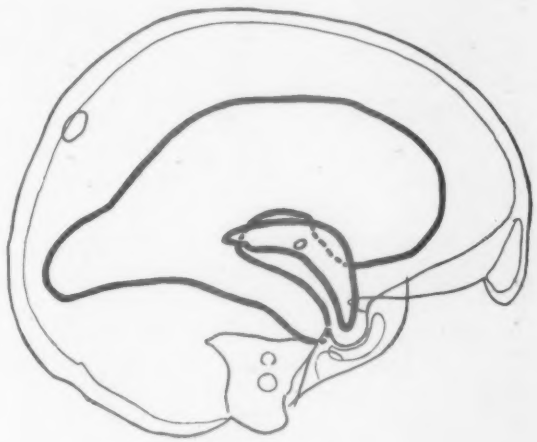


FIG. 8, Case IV.

this portion of the third ventricle and the aqueduct toward the left. These findings as described bear some resemblance to those encountered in thalamic tumors. It is noteworthy, however, that elevation of the floor of the body of the lateral ventricle on the tumor side, always seen to some extent in thalamic neoplasms, is notably absent in this case. Furthermore, the upper portion of the posterior end of the third ventricle is in this case evenly distended with gas, whereas thalamic tumors invariably produce deformity in this region.

### EXTRAMEDULLARY CEREBELLOPONTINE ANGLE TUMORS

Ordinarily, extramedullary tumors in the region of the cerebellopontine angle can be localized without great difficulty on the basis of their neurological manifestations, and ventriculographic examination is unnecessary. The larger lesions, chiefly acous-

* The roentgenogram labeled 7*E* has purposely been printed in reverse to conform to other ventriculograms and sketches in sagittal projection. This roentgenogram was originally produced by exposing the head from above at variance with standard practice.

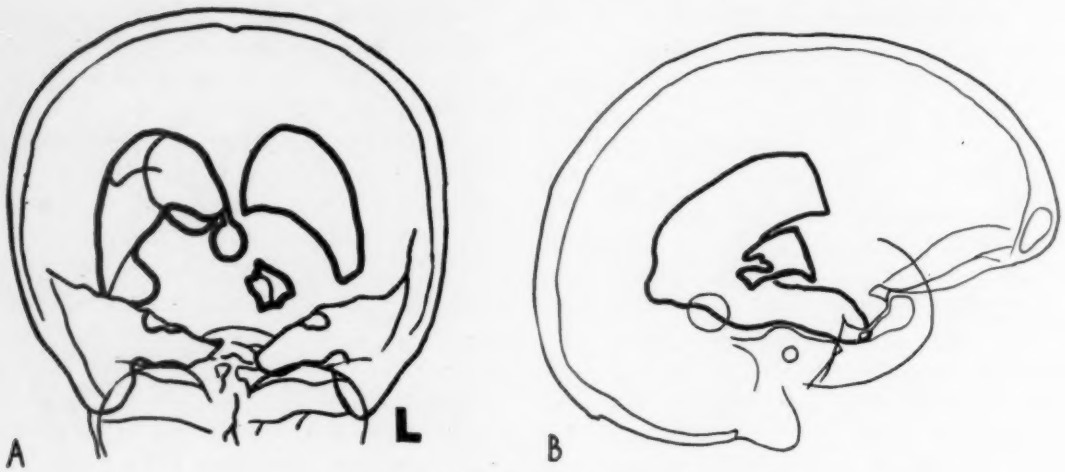



Fig. 9, *A* and *B*. Case v (379438).

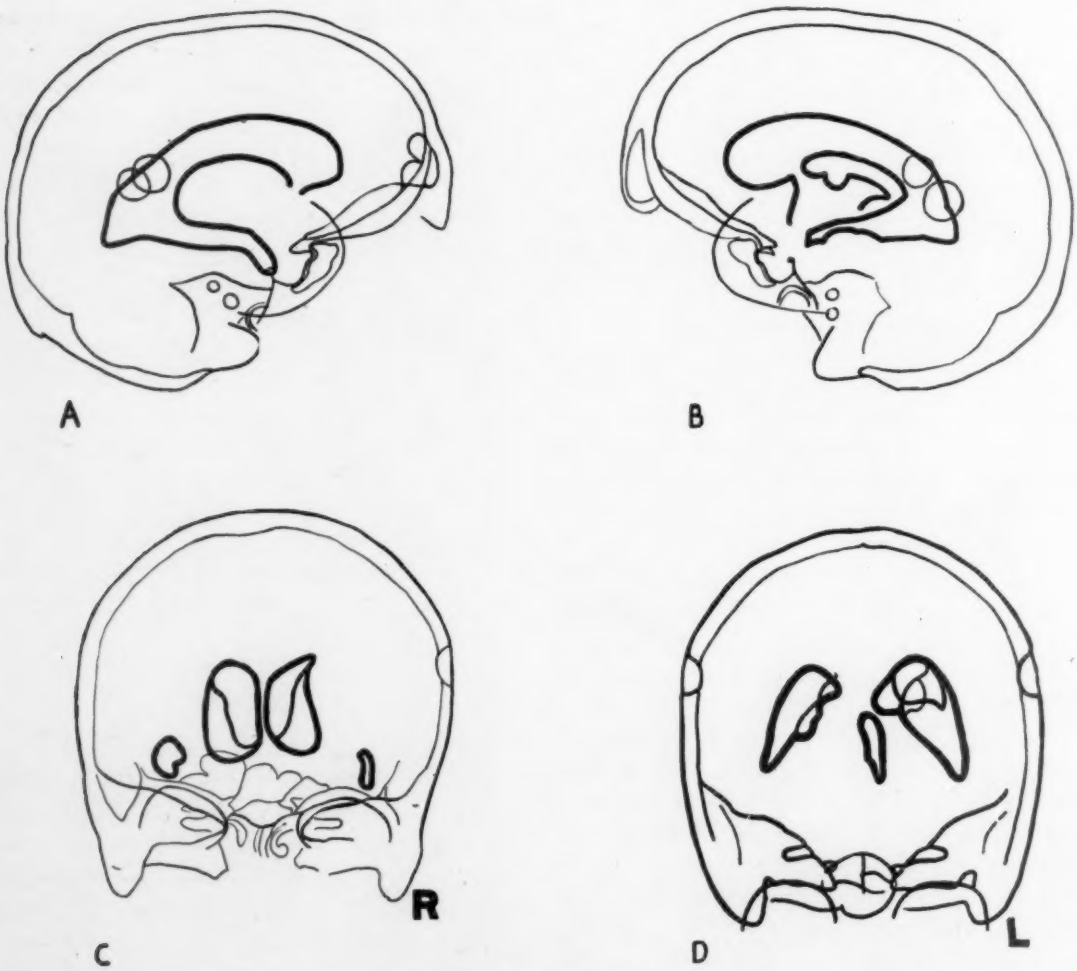



Fig. 10, *A*, *B*, *C* and *D*.
Case vi (348719).

tic tumors, produce displacement or indentation of the pons and compress the aqueduct or the fourth ventricle. The tumor may also extend anteriorly and upward, displacing the brain stem before it through the incisura tentorii. Ventriculographic findings are not unlike those associated with lateralized intrapontine tumors.

Case IV. A single line drawing is here reproduced, illustrating the ventriculographic changes produced by an acoustic neuroma associated with a large cyst. Although this tumor was not studied at this clinic, having been reported by one of us from Dr. Harvey Cushing's series of acoustic neuromas,[2] it is here introduced to exemplify the deformity of the third ventricle produced by anterior displacement of the brain stem, in contrast to actual tumor invasion as seen in the preceding case. Figure 8, a sketch of the ventricular relationships as shown in left lateral projection, shows upward and anterior displacement of the inferior margin of the third ventricle, indistinguishable from intrapontine tumor.

Case V, a right-sided acoustic neuroma, exemplifies slight elevation of the aqueduct as seen in the lateral view, occiput superior (Fig. 9*B*). The degree of aqueduct elevation is very slight, and in this particular lateral sketch only the anterior portion of the aqueduct can be seen. The sketch representing sagittal projection with the occiput superior (Fig. 9*A*) shows marked displacement of the fourth ventricle toward the left, away from the site of the tumor.

It has already been remarked that, in addition to typical displacement and deformity of the aqueduct and the fourth ventricle, subtentorial lesions may produce ventriculographic evidence of changes in the temporal horn of the lateral ventricle. Such findings are only encountered in the case of tumors which extend for a considerable distance along the long axis of the brain stem through the incisura tentorii into the middle fossa (Fig. 4).

Case VI represents an unusual situation in which neurological findings and ventriculographic signs seemed to be incongruous. Typical lower cranial nerve involvement on the right together with some cerebellar symptoms bespoke cerebellopontine angle tumor. Ventriculograms, on the other hand, were characteristic of subtemporal tumor on the right with no signs to indicate a subtentorial lesion. Line drawings derived from original ventriculograms shown in Figure 10 illustrate the important roentgenological findings. In the lateral views (Figs. 10*A* and *B*), the right temporal horn shows localized marginal irregularity as well as upward and outward displacement. The sagittal view with the forehead superior (Fig. 10*C*) shows a slight shift of the lateral ventricle away from the tumor side toward the left. The distance between the temporal horn and the anterior horn of the lateral ventricle is greater on the right than on the left because of the tumor mass lying between these structures. The posterior sagittal view (Fig. 10*D*) shows displacement of the inferior portion of the third ventricle toward the left. All of these features are entirely compatible with a subtemporal tumor on the right side. Obstruction of the aqueduct near its junction with the third ventricle precludes any possibility of recognizing the presence of subtentorial involvement. At operation a large meningioma was found, arising in the subtemporal region and extending through the incisura into the region of the cerebellopontine angle, verifying both the clinical and the ventriculographic observations as to locality of the tumor.

## SUMMARY

Among subtentorial tumors, those which arise within the pons and in its immediate vicinity and those which involve the aqueduct alone are responsible for ventriculographic signs which differentiate them from lesions of the cerebellum and the fourth ventricle.* Intrapontine tumors character-

* This latter group will be discussed in a third section of this communication.

istically displace the aqueduct and the fourth ventricle upward and compress them as well. Lateralized tumors of this sort displace these structures to the opposite side. The third ventricle, when affected by neoplasms in the region of the pons, is involved in its inferior portion only. Unusually extensive tumors may invade structures in the middle fossa or displace the brain stem anteriorly, producing corresponding alterations in the appearance of the lateral and third ventricles.

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Vol. 40, No. 3

# ENLARGED GLOMUS DEFECT CONTRALATERAL TO THE SIDE OF VENTRICULAR PUNCTURE*

## ITS OCCURRENCE DUE TO CYSTS OF THE GLOMUS

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IT IS the purpose of this paper to place on record a second case of an enlarged glomus shadow present on the side contralateral to the ventricular puncture and due to cysts of the glomus of the choroid plexus.

In 1932, Dyke and Davidoff[1] described a normal defect in the lower wall of the lateral ventricle, located at the junction of the body with the occipital and temporal horns, and showed that this defect was due to the projection of the glomus of the choroid plexus into this portion of the lateral ventricle. This defect was visible after encephalography as well as after ventriculography.

After study of a large series, they concluded that 225 sq. mm. was the maximum size for the defect which could be considered within normal limits.

In 1935, Dyke, Elsberg and Davidoff[2] demonstrated that "during puncture of the ventricles in the posterior parietal region for the introduction of air, as ordinarily done, the brain cannula may accidentally come into contact with and traumatize the glomus of the choroid plexus or a vessel in the wall of the ventricle. This may produce a hematoma or edema . . . which can be recognized on the roentgen films as a defect [over 225 sq. mm.] in the outline of the lower wall of the lateral ventricle situated in or near the position of the glomus;" that this enlarged defect was never observed if encephalography was done; that "whenever doubt exists as to whether the defect is due to a traumatic lesion or to some other cause, encephalography may be done a week later to clarify the point, for a traumatic lesion will then have largely disappeared;" that in one case, an enlarged defect on the side contralateral to the ventricular puncture was proved to be due to retention cysts of the glomus of the choroid plexus as shown at necropsy.

### CASE REPORT

M. H., male, aged fifty-five, was subjected to a left ventricular puncture for ventriculography

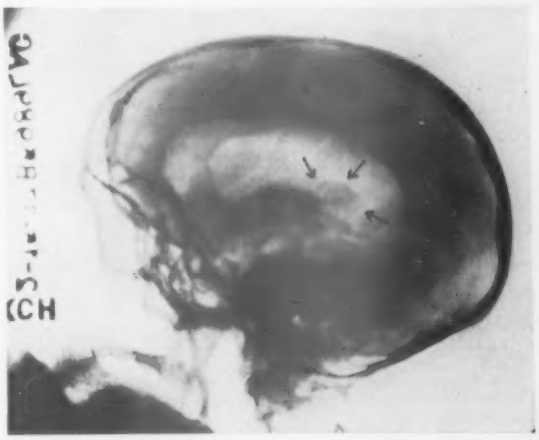

FIG. 1. Lateral view showing dilatations of the ventricular system except the fourth ventricle. Arrow shows enlarged glomus shadow.

due to the fact that roentgenographically there was evidence of a tumor in the right upper lung field and that clinically there was a picture of increased intracanial pressure.

The films showed both lateral ventricles, the third ventricle and the aqueduct of Sylvius to be dilated. The fourth ventricle was not visualized. The conclusion was that there was a lesion causing obstruction in the region of the fourth ventricle which was probably secondary to the lung lesion.

In addition there was visualized a large defect having an area about 700 sq. mm. in the region of the glomus on the side contralateral to the ventricular puncture.

* From the Roentgenological Division of the Kings County Hospital of the Department of Hospitals of the City of New York, Dr. Richard A. Rendich, Director.

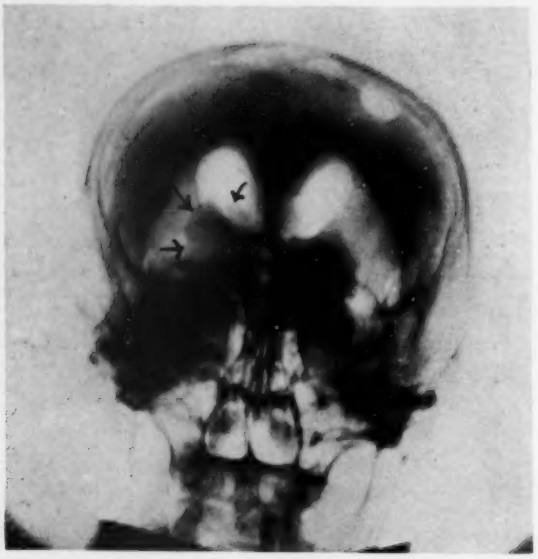

FIG. 2. Posteroanterior view. Arrow shows enlarged glomus shadow on the side contralateral to the trephine defect.

An operation performed by Dr. E. Jefferson Browder on Februrary 16, 1937, revealed: (1) multiple cysts of the glomus of the choroid plexus on the right side; (2) tumor mass in the cerebellum causing pressure on the fourth ventricle.

At autopsy performed on February 28, 1937, by Dr. Hala, there was found: (1) adenocarcinoma of the right upper lung lobe with metastasis to the cerebellum; (2) silver clips at the site where the cysts of the glomus of the choroid plexus had been removed.

## DISCUSSION AND CONCLUSION

1. The visualization of an enlarged glomus shadow on the side contralateral to a ventricular puncture is abnormal and is unrelated to the ventriculography.

2. This enlargement has been shown by Dyke, Elsberg and Davidoff and now by us for the second time to be due to cysts of the glomus.

3. From a pathological viewpoint, this enlargement may also be caused by benign hypertrophy or by other tumors of the choroid plexus as well as by tumors in the adjacent region.

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Vol. 40, No. 3

# THE SHAPE OF THE FEMALE PELVIS AND ITS CLINICAL SIGNIFICANCE

## FURTHER ROENTGEN STUDIES*

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THE normal female pelvis varies in shape as well as in size, and as long ago as 1844 Stein[9] classified female pelves into four types: the round, the blunt-heart shaped, the elliptical in the anteroposterior diameter and the elliptical in the transverse diameter. The obstetrical significance of these variations in shape was summarized four years ago by Caldwell and Moloy[1] as follows: The round or gynecoid type has usually no significance, except in the small, generally contracted form; the blunt-heart shaped or android type has usually considerable significance, forceps often being necessary, and, if marked cases are diagnosed before the onset of labor, cesarean section can be sanely advised; the sagittal ellipse or anthropoid form has variable significance, rotation of the head often being difficult; the transverse ellipse or platypelloid form has considerable significance since the head must not be rotated into the narrowed anteroposterior diameter.

Two years ago, Pettit, Dunn, Shumaker and I[8] studied 100 consecutive primigravidae, classified their pelves according to the method of Caldwell and Moloy and then correlated the findings with the observed course of labor in an effort to confirm or disprove the conclusions of those authors. In addition, since the incidence of dystocia in that group was low (17 per cent), a group of 14 cases of known dystocia, in which ordinary clinical pelvimetry had failed to forecast the difficulty, was also studied. Our conclusions at that time were that the morphologic classification was a clinically feasible one and that, in a significant number of cases, a difficult labor could be forecast in patients whose obstetrical measurements by ordinary methods appeared normal.

However, we felt (*a*) that in the roentgen diagnosis of the different types of pelvis too much depended on subjective or personal opinions and too little on actual measurements, and (*b*) that a larger series of cases was desirable really to confirm the validity of our conclusions in regard to the prediction of dystocia. Accordingly, the study was continued and measurements were recorded both of the linear dimensions and of the angles of the various architectural features relied upon in diagnosis. The present paper is a review of those measurements in the last 150 cases and a critique of the accuracy of our roentgen technique in really reproducing the structures under survey.

### ROENTGEN TECHNIQUE

The architectural features on which we base this morphologic classification are (1) the pelvic inlet, (2) the subpubic arch and (3) the greater sciatic notch and sacrum. In the original investigation the shape of the ischial spine was also studied, but increasing experience has led us to feel that, under average roentgenological conditions, the clarity of reproduction of this spine in the lateral projection of the gravid pelvis is so poor that it is not of value as an anatomical guide; slight degrees of rotation are difficult to avoid and this adds to the problem of interpretation.

Since the technique used is of considerable importance we shall consider this matter in some detail.

1. *The Pelvic Inlet.* It is well known that in order to reproduce the shadow of an object accurately it is important to have it as nearly parallel to the film as possible. The pelvic inlet with the patient recumbent is normally moderately oblique. This obliquity is materially reduced by the insertion

* From the Departments of Radiology and Obstetrics and Gynecology, Stanford University Medical School, and the Department of Public Health, San Francisco. Read at the Fifth International Congress of Radiology, Chicago, Ill., Sept., 13–17, 1937.

of a 4-inch thick pillow under the patient's lumbar region. (It is important to define our terms. By pelvic inlet we mean the plane of the true conjugate or anteroposterior diameter of the pelvic brim, as measured from the anterior superior margin of the first sacral vertebra to the back of the superior margin of the symphysis pubis. We grant the validity of Moloy and Swenson's[8] point that the "clinical inlet" is better measured from the top of the symphysis pubis to the lower portion of the first sacral vertebra at the level of the terminations of the iliopectineal lines, but for purposes of the present discussion we adhere to the conventional or "obstetrical inlet.")

By careful measurement of lateral projections of a group of non-gravid female pelves we discovered, to our surprise, that the average angle of the inlet relative to the horizontal plane, with the patient recumbent and the legs extended, was 18 degrees (and not the 42 degrees reported in the literature!). By using a lumbar pillow 4 inches thick the average angle became 6 degrees. The following table summarizes the findings:

| Number of Cases | Average Age | Average Weight lb. | *Angle of Pelvic Inlet Above the Horizontal with Patient Lying Supine* Without Pillow min. | aver. | max. | With Lumbar Pillow min. | aver. | max. |
|---|---|---|---|---|---|---|---|---|
| 14 | 25 | 139 | *8* | **18** | *35* | *−4* | **6** | *18* |

In a group of 14 fully gravid females, kindly measured by Dr. R. R. Newell, the average angle of pelvic inclination with the patient recumbent without pillow was found to be 31 degrees, the minimum being 20 and the maximum 45 degrees. With a lumbar pillow the average angle in these gravidae would be reduced to approximately *20* degrees. The optimum projection to reproduce an object inclined at 20 degrees requires a beam at right angles to the bisecting angle, that is, in the case of the pelvis, a beam angled 10 degrees caudad.

Jacobs[5] measured the inclination of the pelvic inlet with a special "inclinometer" and states that the angle varies from 7 to 70 degrees, the average being 42 degrees. However he does not give the number of cases studied nor does he say whether the patients were pregnant or not. His illustrations suggest that the angle is nearer 20 than 40 degrees. Garnett and Jacobs[4] report similar observations in a later paper, the former intimating that the eighth month of pregnancy was chosen as the time to measure inclination. Scott, in discussing that paper, observed that the pelvic inclination may change considerably during gestation, sometimes as much as 17 degrees. From our brief experience we believe this is possible.

Moloy and Swenson[8] discuss the question of the obliquity of the pelvic inlet at considerable length but give no figures. Friedman, Michels and Rossitto[2] advise the semirecumbent position to avoid obliquity. We have satisfied ourselves that a lumbar pillow is sufficient.

In summary then, we can say that the angle of the pelvic inlet relative to the horizontal plane is quite variable, but is much less marked than previously believed. If a 4-inch thick lumbar pillow is used and the tube is tilted 10 degrees caudad, the inlet will be reproduced with reasonable accuracy in the majority of cases. Clinical attention is paid only to clear-cut degrees of morphologic variation and slight tilting either side of the correct angle will rarely cause confusion. If the obturator foramina are visible as anything but very foreshortened ellipses the film ought to be retaken; with care, this will occur in less than 10 per cent of cases.

Stereoscopic roentgenograms are made only when it is desired to combine accurate linear measurement, pelvimetry, with morphologic measurement, pelviography. To convince one of the senior members of the Obstetrical Department that stereoscopic films were not necessary for routine pelviography, we made such films in 25 consecutive cases and classified the individual

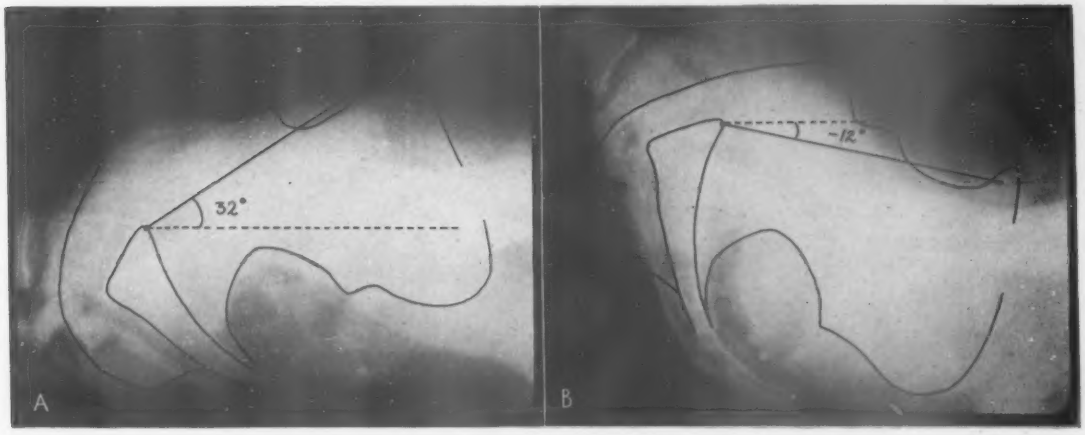


Fig. 1. *Inclination of the Pelvic Inlet.* The films are made with the patient recumbent, legs extended, on a flat table, (*A*) without lumbar pillow and (*B*) with lumbar pillow 4 inches thick under the lumbar region. The degree of pelvic inclination is measured relative to the horizontal. The average inclination in nongravid women, without pillow, is 18 degrees, with pillow 6 degrees; in gravidae at the ninth month, without pillow 30 degrees, with pillow 20 degrees.

Note: For purposes of illustration a patient with relatively large inclination is shown; the lumbar pillow is a 6-inch thick one, not the ordinary 4-inch one; hence the change from 32 to −12 degrees.

pelves first by a plain film and then by the stereoscopic set; in no case was it necessary to revise the interpretation. Of course, stereoscopic films are of much value in studying cephalopelvic relationships and, as Caldwell and Moloy stress, "precision" stereoscopic studies are invaluable for roentgen studies during labor. But since lateral and subpubic projections are made in addition to the plain view of the inlet in all cases, it is obvious that stereoscopic studies of the latter are superfluous.

(The obstetrical significance of pelvic inclination is stressed by Jacobs, Friedman *et al.*, and others, since it is apparent that as it approaches the horizontal with the patient recumbent, engagement becomes more difficult. Conversely, engagement may be facilitated by flexing the patient's thighs, thereby increasing the vertical inclination of the inlet.)

2. *The Subpubic Arch.* The angle made by the inferior pubic rami is called the subpubic angle. The obstetric significance of a "narrow" subpubic angle being considerable, it appeared important to us to devise some means of measuring it objectively (in degrees).

The optimum projection for reproducing the subpubic arch is obviously that which permits it to lie as near to and as parallel with the cassette as possible. At the kind suggestion of Dr. R. R. Newell, projections were made with a 5″×7″ cassette applied against the perineum, the patient squatting on the cassette supported on a high narrow stool. This resulted in an accurate repro-

Fig. 2. *Plane of the Subpubic Arch, Relative to the Horizontal.* Lateral projection of dried pelvis tilted at an average normal angle; target-film distance 48 inches. Note that the inclination of the pubic arch is 66 degrees; the bisecting angle is therefore 33 degrees and the correct tube tilt 33 degrees cephalad.

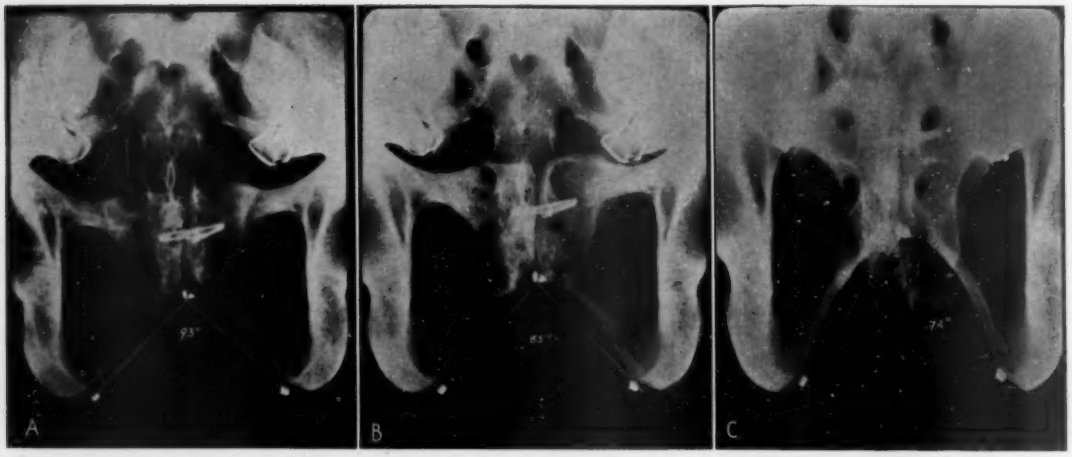


FIG. 3. *Subpubic Arch:* Influence of technique on the apparent width of the subpubic angle. All illustrations are of the same pelvis, placed on the table so that the vertical plane of the pubis is at an angle of 66 degrees with the horizontal (the average normal recumbent tilt); the pelvis is raised 3 inches from the cassette to simulate normal elevation; the target film distance is 36 inches. *A* is made with a tube tilt 30 degrees cephalad (author's previous technique), *B* with a tilt 33 degrees cephalad (correct technique), *C* with a tilt 45 degrees cephalad (Caldwell-Moloy technique). The actual subpubic angle measured on the dried pelvis is 85 degrees. It is readily seen that the bisecting angle or 33-degree technique is the correct one. It is also seen that our previous 30-degree angle, while not perfect, produces much less distortion than the 45-degree angle recommended in the literature.

duction of the angle but was awkward for the patient. Studies on a dried pelvis and also on a score of living subjects revealed that in the supine position (without lumbar pillow) the average plane of the subpubic arch was one inclined 66 degrees to the horizontal. The optimum tube tilt to reproduce such plane in the anteroposterior

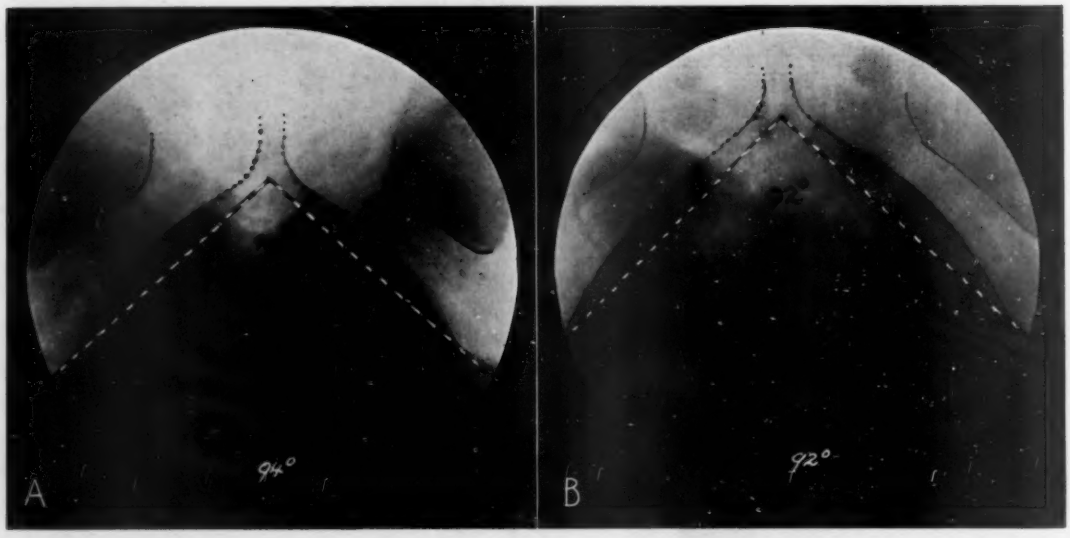


FIG. 4. *Subpubic Arch:* Comparison of author's 30-degree anteroposterior technique with special "contact" posteroanterior technique, in same patient. The latter technique results in almost no distortion of the angle since the patient "squats" with the pubic arch in contact with the cassette. However, the technique is awkward for the patient and the modified anteroposterior projection is preferable, especially since, with a little care in "bisecting the angle," almost no distortion is produced (94 degrees instead of 92 degrees, in the case illustrated, a distortion of less than 3 per cent). NOTE: In reproduction the "contact technique" film (*B*) is slightly enlarged.

projection is one at right angles to the bisecting angle or a tilt 33 degrees cephalad. In this respect our figures approach those of Garnett and Jacobs, who report an average of 60 degrees.

Comparison was then made of our anteroposterior technique with the special direct posteroanterior technique and, to our relief, it was found that, while magnified, the image in the former represented the satisfactory for detailed analysis or measurement owing (*a*) to slight rotation of the patient, (*b*) to poor films in wide patients or (*c*) to confusing motion of fetal osseous or maternal gaseous shadows. For these reasons accurate measurements of the sciatic notch and the ischial spine have not yet been compiled. However, it is comparatively easy to measure the sacral inclination, relative to the inlet, and also the depth of

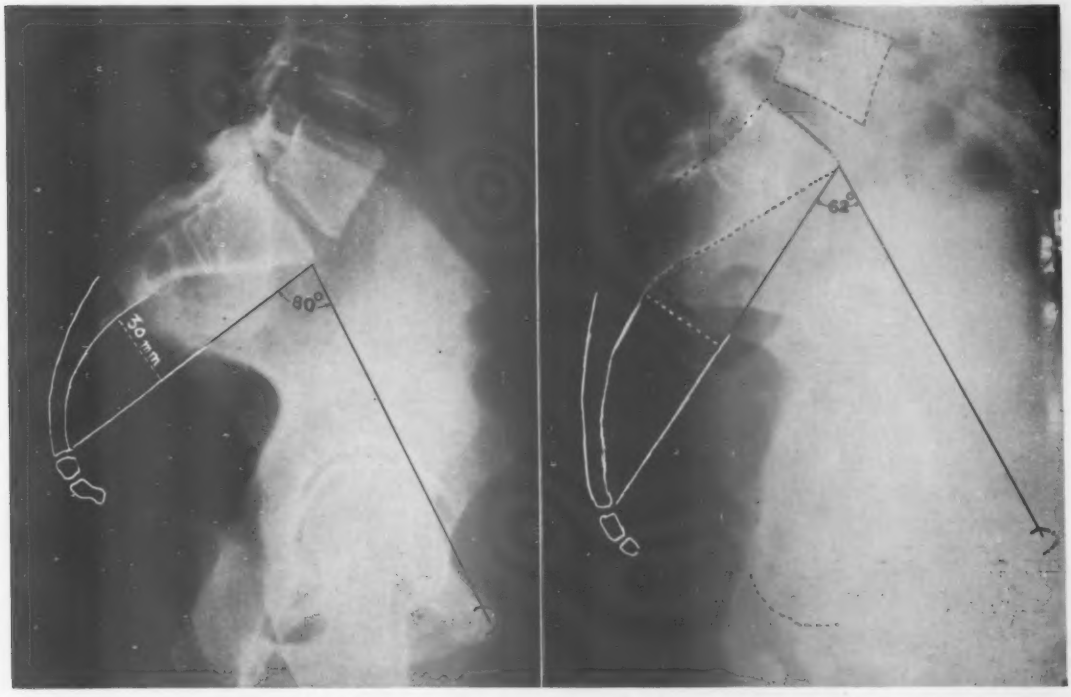


Fig. 5. Illustration of the methods used to measure the inclination of the sacrum (relative to the plane of the pelvic inlet) and the depth of curvature of the sacrum.

true angle of the arch. As in the case of the inlet, a certain number of patients require a tube tilt more than or less than 33 degrees for correct reproduction, but in the majority of cases the latter will be satisfactory. (The second series of 150 cases was well under way when this new tilt of 33 degrees was decided upon and we therefore adhered to our former technique of 30 degrees for the remainder of the present series.)

3. *The Greater Sciatic Notch, Sacral Inclination and Sacral Curve* (*Lateral Pelvis*). The true lateral projection of these structures is theoretically simple but in actual practice a high percentage of films is unthe concave curve of that bone—although the actual significance of such measurements now appears to be but slight.

*Summary of Technique.* (All films made on a Potter-Bucky diaphragm, at 36-inch distance, using light compression.)

Pelvic Inlet: Patient supine; pillow 10 cm. thick under lumbar region; tilt tube 10 degrees caudad; aim central ray 1 cm. below the level of the anterior superior iliac spine; 80 kv., 15 ma., time 4 seconds.

Subpubic Arch: Patient supine; no pillow; tilt tube 33 degrees cephalad; aim central ray on the middle of the pubic arch; 80 kv., 15 ma., time 4 seconds.

Lateral Pelvis: Patient lying on her side, with pad under the flank to make the axis of the sacrum as nearly parallel to the film as possible; no tube tilt; aim central ray through the upper part of the greater trochanter; 80 kv., 15 ma., time 20 seconds.

posterior segment belongs to a definite type. These modifications are of considerable significance in the individual case but, for purposes of brevity, are not listed in the tables published with this paper. An android pelvis is often significant but an android pelvis with wide subpubic arch and wide (anthropoid) sciatic notch, especially when the inlet is large, probably means an easy labor. Similarly, a gynecoid pelvis has usually a good prognosis, but a gynecoid pelvis with a narrow subpubic arch, converging side walls and a narrow notch may prove troublesome. Of course, the significance of any one type is rarely absolute; pelviograms do not forecast the power of

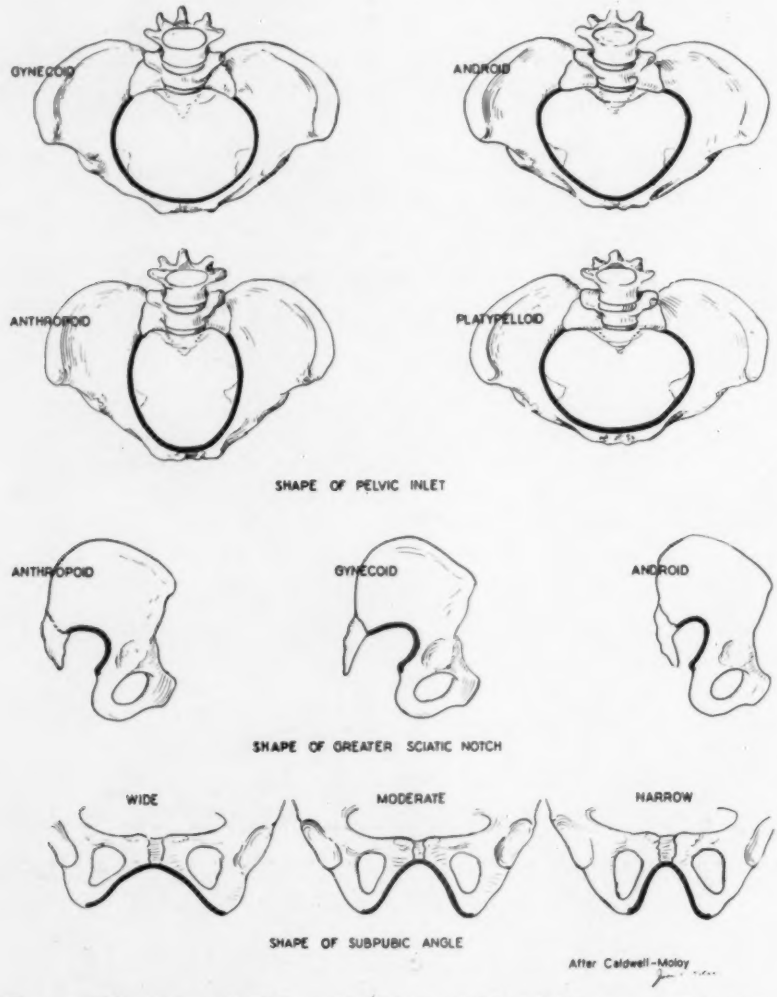


FIG. 6. Diagrammatic illustration of the differential features of the four principal morphologic types of female pelvis.

ROENTGEN INTERPRETATION

The differential diagnosis of the various morphologic types of female pelves is based chiefly on the shape and appearance of the posterior segment of the pelvic inlet as seen in the anteroposterior film. The shape of the anterior segment of the inlet, of the subpubic arch and of the greater sciatic notch serve as modifying features but do not alter the basic classification when the

uterine contraction, the rigidity of the soft parts or the judgment of the obstetrician; they merely are a valuable guide in some clear-cut cases.

The pelvic inlet is classified according to the features outlined in Figure 6 and Table I.

Table I

DIFFERENTIAL FEATURES OF THE VARIOUS TYPES OF FEMALE PELVIS
(After Moloy and Swenson)

| Type | Pelvic Inlet | | | Subpubic Angle | Greater Sciatic Notch | Inclination of Sacrum |
|---|---|---|---|---|---|---|
| | General Outline | Posterior Segment | Anterior Segment | | | |
| Gynecoid | "Round" shape | Long, curved posterior iliac sections; curved posterior segment | Broad, curved anterior segment | Moderate to wide (well curved inferior pubic rami) | Average (female type) | Average |
| Android | "Blunt-heart" or "triangular" shape | Short, straight posterior iliac sections. Wide and flat posterior segment | Wedge-shaped or narrow anterior segment, with straight margins | Narrow (straight type of rami) | Narrow (male type) | Forward |
| Anthropoid | Long, oval shape | Long, curved posterior iliac sections. Long and slightly narrow posterior segment | Long and slightly narrow anterior segment | Wide (well curved type of rami) | Very wide | Backward |
| Platypelloid | Transverse oval shape or ellipse | Wide and flat posterior segment | Wide and flat anterior segment | Moderate (well curved type of rami) | Under average (foreshortened type) | Average |
| Mixed | Variable | Posterior segment dominates the classification | Variable (one type of anterior segment with another type of posterior segment) | Variable | Variable | Variable |

Having decided on its classification, it is simple matter to measure the anteroposterior and transverse diameters and, if desired, correct the figures obtained by the factors given below. This will give the approximate true conjugate and transverse diameter. These figures are useful in classifying the inlet as large, average or small in size but, of course, are not to be relied upon for accurate linear measurements. This method of correction is reliable in the majority of cases since we have shown that the pelvic inlet is properly reproduced by the technique given. It merely requires the preliminary measurement of the distance from the top of the symphysis to the film.

| Distance of Inlet to Film (inches) | Factor of Magnification (per cent) | To Correct Magnification Deduct (per cent) |
|---|---|---|
| 5 | 16 | 14 |
| 6 | 20 | 17 |
| 7 | 24 | 20 |
| 8 | 30 | 23 |

According to the literature, 12.5 to 10.5 cm. is the average range for the anteroposterior diameter, and 13 to 11 cm. the average for the transverse diameter of the inlet; gynecoid and android pelves with measurements above these figures may be classified as large, and below them, as small. Anthropoid and platypelloid pelves obviously need special consideration; at first, we thought that by increasing the anteroposterior figures and decreasing the transverse figures 1 cm. each we would allow for average anthropoid types, and the reverse for average platypelloid types. However, actual measurements of these two groups revealed this to be erroneous and we now rely on the following figures:

| | Average Antero-posterior Diameter of Inlet | Average Transverse Diameter of Inlet |
|---|---|---|
| Gynecoid | 155–135 | 165–140 |
| Android | 165–140 | 155–140 |
| Platypelloid | 145–125 | 165–145 |

NOTE: These are uncorrected figures in mm. read directly from the films; pelves with dimensions above these are termed "large" and below these "small."

*The Subpubic Angle.* The width of the subpubic angle was measured by drawing straight lines between the midpoint of the inferior portion of the symphysis pubis and the two sides of the inferior pubic rami, and reading off with a protractor the angle thus made. The vertical height, and the width of the inferior, horizontal line of the subpubic triangle was also measured but we did not feel the data were sufficiently reliable to warrant analysis. The correction factor becomes too complicated for simplicity. For this reason we also did not record the length of the pubic rami nor the depth of the true pelvis as Caldwell and Moloy have attempted (chiefly, apparently, by estimation).

To illustrate the error inherent in personal estimation of the subpubic angle (as contrasted with actual measurement) we tabulated all cases classified as wide, average and narrow and found that we frequently *described* an arch as wide when it was merely average, and vice versa. After reading films of, say, 2 cases who happened to have narrow arches we might read a film of a patient with an average arch but, owing to illusion, would classify it as wide. From analysis of the 150 cases, using the 30-degree angle technique described above, we believe it is reasonable to classify subpubic angles as follows:

| | |
|---|---|
| Wide | over 100 degrees |
| Average | 100–90 degrees |
| Narrow | under 90 degrees |

*The Greater Sciatic Notch and Other Features.* The interpretation of the shape of the sciatic notch, the inclination of the sacrum and the size of the ischial spine require careful study of the film. Unfortunately in the films of thick, gravid patients bony contours are sometimes not very sharp, while in very thin patients there is frequently slight rotation; these factors, plus the presence of confusing shadows due to bowel contents, often prevent exact interpretation. We attempted to measure the width of the greater sciatic notch, and the width and depth of the ischial spine in order to eliminate the personal equation in deciding whether these features were anthropoid, gynecoid or android in shape, but were not successful in doing so. The notch does not lend itself to simple geometric analysis and the spine is all too often indistinct. We therefore tried to measure the two remaining features, namely, the inclination of the sacrum relative to the inlet and the depth of the concave curve of the sacrum (as described in our previous paper). While the figures obtained suggest that these features vary too greatly, independent of type, to be of value in classification, we believe with Caldwell and Moloy, that they may be very significant in the individual case.

## DISCUSSION OF ROENTGEN FINDINGS

The relative incidence of the various types of pelves in the present series is practically identical with that reported in our first series, which is to be expected, since the material comes from the same source (the Obstetrical Clinic of the San Francisco Hospital). The number of platypelloid

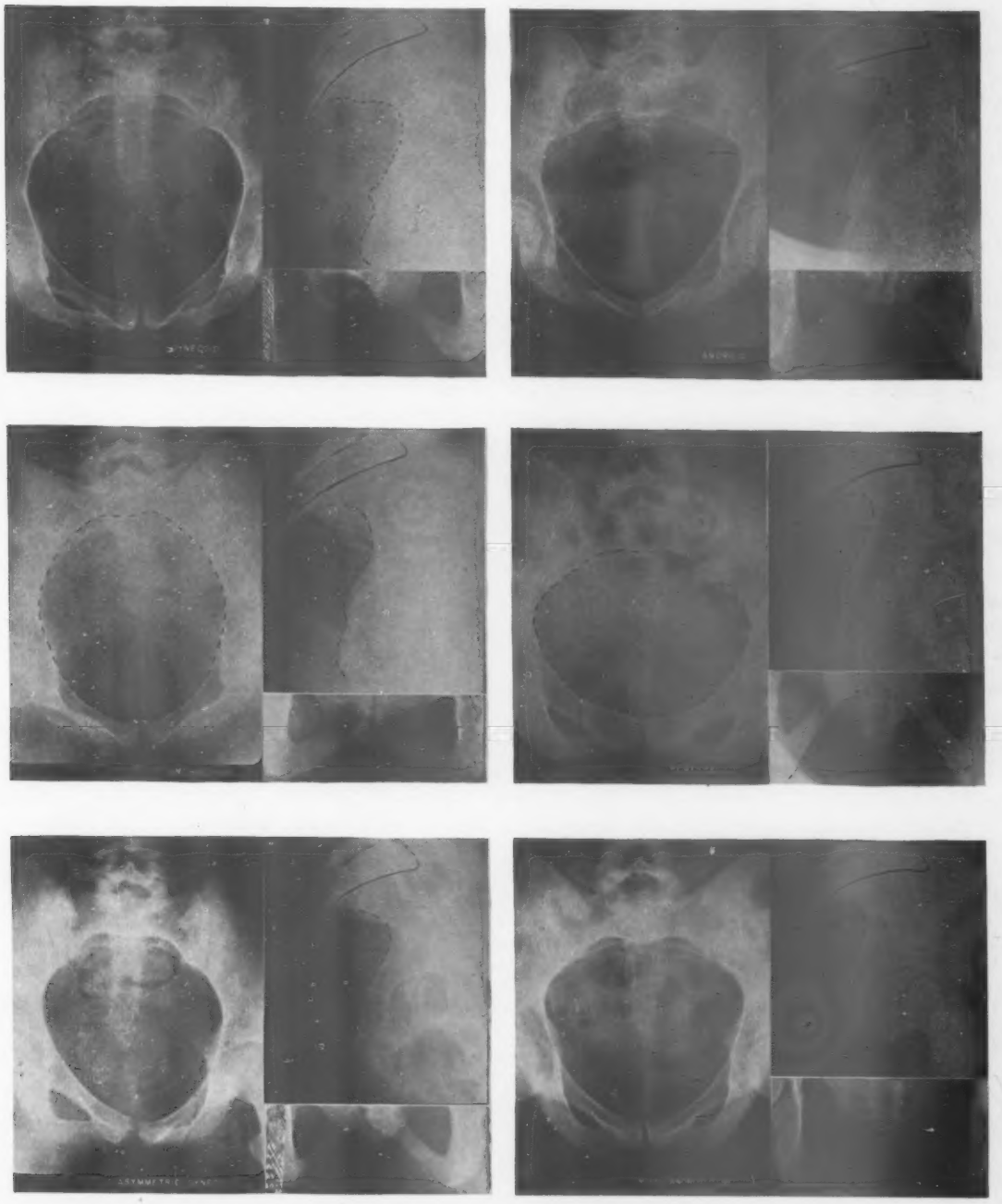

Fig. 7. Typical architectural types of female pelves. Top left: *Gynecoid* pelvis, large inlet, wide subpubic angle. Top right: *Android* pelvis, average inlet, average subpubic angle. Center left: *Anthropoid* pelvis, average inlet, wide subpubic angle. Center right: *Platypelloid* pelvis, average inlet, narrow subpubic angle. Lower left: *Asymmetric* (*gynecoid*) pelvis, small inlet, average subpubic angle. Lower right: *Mixed* (*android-gynecoid*) type, average inlet, average subpubic angle.

cases was larger, while the number of asymmetric cases was smaller.

As far as the size of the inlet is concerned it is to be noted that Caldwell and Moloy found, in their series of 215 cases of primigravidae, 25 per cent with large inlets, 50 per cent with average inlets and 25 per cent with small inlets. Small inlets were

TABLE II

RELATIVE INCIDENCE OF THE VARIOUS TYPES OF FEMALE PELVIS*
(in percentages)

| Type | Caldwell and Moloy 215 Unselected Primigravidae 1934 | Moloy and Swenson 1936 | Author's First Series of 100 Unselected Primigravidae 1936 | Author's Second Series of 150 Unselected Primigravidae 1937 |
|---|---|---|---|---|
| Gynecoid | 58 | 51 | 53 | 51 |
| Android | 22 | 19 | 21 | 21 |
| Anthropoid | 18 | 26 | 21 | 18 |
| Platypelloid | 1 | 4 | 5 | 10 |

* Cases with mixed or asymmetrical tendencies were grouped with the predominant or parent type. The measurements obtained in the entire group are shown in Table III.

proportionately twice as common in the android group as in the whole group and large inlets almost twice as common in the anthropoid group. In our present series, 28 per cent had large inlets, 58 per cent average inlets and only 14 per cent small inlets. Making allowance for the anatomical differences previously noted, we did not find a disproportionate number of small inlets in the android group or large inlets in the anthropoid group.

In our previous publication we found that the average duration of labor (that is the number of hours in the first and second stages) in the pure types was as follows: platypelloid thirteen hours, gynecoid and anthropoid fifteen hours, android twenty hours. It was also observed that while only

TABLE III

DIFFERENTIAL FINDINGS IN THE VARIOUS TYPES OF FEMALE PELVIS
(Author's Second Series)

| *Inlet* (Measured in mm. directly on the films. For correction factors see text) | | | | | | *Type* | *Subpubic Angle* (Measured in degrees, using tube tilt 30° cephalad) | | | *Inclination of Sacrum* (Measured in degrees directly on the lateral films) | | | *Curvature of Sacrum* (Measured in mm. directly on the films. For correction factor see text) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anteroposterior | | | Transverse | | | | | | | | | | | | |
| min. | av. | max. | min. | av. | max. | | min. | av. | max. | min. | av. | max. | min. | av. | max. |
| *121* | **143** | *180* | *120* | **153** | *180* | *Gynecoid* 76 cases 51% | *73* | **99** | *118* | *56* | **69** | *87* | *9* | **25** | *42* |
| *125* | **145** | *175* | *125* | **156** | *176* | *Android* 31 cases 21% | *75* | **96** | *116* | *57* | **70** | *91* | *14* | **28** | *45* |
| *146* | **146** | *176* | *133* | **148** | *171* | *Anthropoid* 27 cases 18% | *79* | **95** | *115* | *57* | **70** | *90* | *12* | **30** | *45* |
| *120* | **133** | *164* | *137* | **159** | *168* | *Platypelloid* 16 cases 10% | *84* | **104** | *120* | *54* | **69** | *80* | *19* | **26** | *45* |

13 per cent of the pure gynecoid types required instrumental interference for dystocia, 40 per cent of the pure android types required such (the figures for anthropoid being 28 per cent, and for platypelloid 33 per cent). The clinical findings in our present series are now under scrutiny and will shortly be reported by Dr. Pettit.

Table IV

CLINICAL SIGNIFICANCE OF THE VARIOUS TYPES OF FEMALE PELVIS
(After Moloy and Swenson)

| Type | Incidence (at Sloane Hospital) | Engagement | | | | Prognosis | Forceps |
|---|---|---|---|---|---|---|---|
| | | Posterior Oblique | Transverse | Anterior Oblique | Occiput Anterior | | |
| | per cent | per cent | per cent | per cent | per cent | | |
| Gynecoid | 51 | 10 | 69 | 20 | 1 | Good | Not necessary |
| Android | 19 | 21 | 71 | 8 | 0 | Midpelvic arrest in *transverse* or posterior position | Cephalic application, rotation with axis traction or low rotation |
| Anthropoid | 26 | 29 | 37 | 17 | 17 | Midpelvic arrest in *posterior* or transverse position | Immediate rotation to anteroposterior diameterbefore traction is attempted |
| Platypelloid | 4 | — | — | — | — | Transverse arrest | Maintain transverse position with traction and low rotation |

### COMBINATION OF PELVIMETRY WITH PELVIOGRAPHY

It is sometimes desirable to combine both morphologic studies and accurate linear measurements. Caldwell and Moloy achieve this by making stereoscopic anteroposterior films of the inlet and using them both for mensuration and classification. They use an elaborate prism stereoscope, called a "precision stereoscope," for measurements. This has certain objections: (1) it requires fairly constant use for accuracy, (2) it requires that films be made with no tube tilt, with resultant tendency to imperfect reproduction of the inlet and (3) it is an extremely expensive instrument.

Using Johnson's application of McKenzie-Davidson's method we have attempted to combine pelvimetry with pelviography, using the stereoscopic anteroposterior films both for measurement and classification. We have not found it practical for the following reasons: (1) the roentgen pelvimetry method requires that films be made without tube tilt; (2) our experience with "pelviography" is based largely on films made at a 36-inch target film distance, but our measuring equipment is designed for a 25-inch film distance; we have found it a little difficult to interpret the films made at the shorter distance. This would be overcome with experience but it is not easy to build up a "large" experience in this field.

Accordingly, we believe it is advisable to study the pelvis by each method separately, when called upon to furnish complete information. Since the majority of female pelves are well within the normal limits in *size*, it will usually be of value merely to study them from the point of view of *shape*. However, in cases where pelvimetry is indicated as well, we believe that the method described by Johnson[6] is simple and accurate.[7]


## SUMMARY

Female pelves may be classified on a morphologic or architectural basis into four main types, termed gynecoid, android, anthropoid and platypelloid.

In a group of 150 unselected primigravidae the incidence of these types was found to be as follows: gynecoid 51 per cent; android 21 per cent; anthropoid 18 per cent; platypelloid 10 per cent. Approximately 79 per cent were pure types and 21 per cent mixed types.

The size of the pelvic inlet, the width of the subpubic angle and the shape of certain other anatomical features were carefully measured in this series of cases; these data are of value in arriving at the correct roentgen interpretation but are independently variable within wide limits.

The inclination of the pelvic inlet relative to the horizontal, with the patient recumbent, was studied and it was found that in the average case it is approximately 20 degrees (not 42 degrees as reported in the literature). The clinical significance of this finding in connection with certain classical obstetrical maneuvers is obvious.

With reasonable care, the shape of the female pelvis can be readily diagnosed by a set of three roentgenograms, and, especially in the android type, a potentially difficult labor can be forecast in patients whose obstetrical measurements by ordinary clinical methods appear normal.


I wish to express my acknowledgment to Dr. R. R. Newell and to Drs. A. V. Pettit and R. D.Dunn for their kind advice and cooperation.

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Vol. 40, No. 3

# ROENTGENOLOGICAL DIAGNOSIS OF PERINEPHRITIC ABSCESS AND PERINEPHRITIS*

*By* ALBERT E. GOLDSTEIN, M.D., F.A.C.S., AND MARCUS OSTRO, M.D.
BALTIMORE, MARYLAND

FREQUENTLY a roentgenological study is necessary in the diagnosis of urological conditions. The diagnosis of perinephritis and perinephritic abscess is very often a difficult problem. Unfortunately most lesions of the urinary tract aside from calculi, etc., are best visualized in the roentgenogram when an opaque solution is injected into the urinary tract. When there is a lesion in the immediate vicinity of the urinary tract, but not necessarily connected with it, then the problem is more difficult to solve from a roentgenological standpoint. Various observers have recognized after careful study that infections surrounding the kidney or ureter do materially alter the anatomical contour of various structures.

A careful roentgenogram of these structures as compared to the known contour is of assistance in making deductions. Providing a good clear view is observed on the roentgenogram, these comparisons can be made on the same plate or on other known roentgenograms.

In an effort to diagnose perinephritic abscess, the points of particular interest in the study of the plain roentgenogram of the urinary tract where no ureteropyelogram has been made are as follows, in the order of their importance: (1) the psoas muscle shadow; (2) the determination of curvature of the lumbar spine; (3) the outline of the renal shadow; (4) the position of the renal shadow in the horizontal and erect postures, and (5) the visibility of the shadow of the transverse processes.

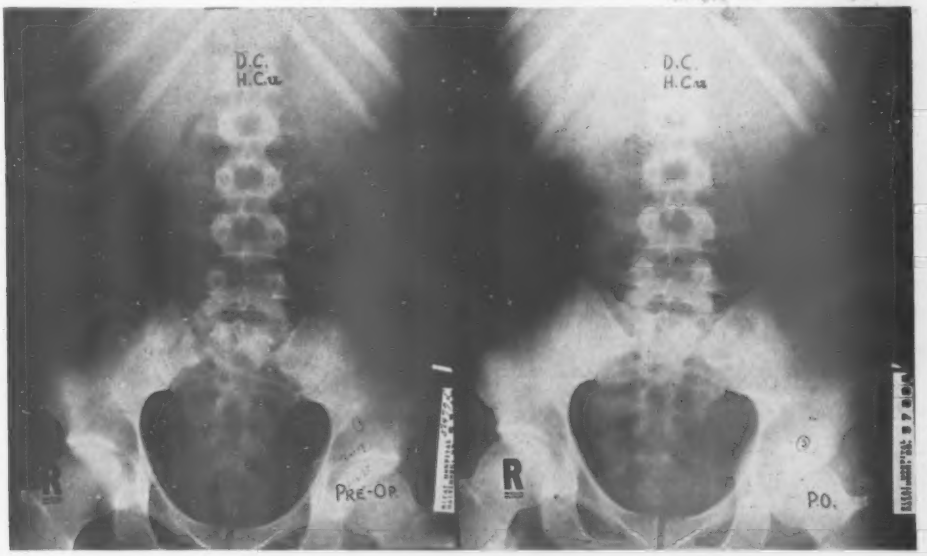


FIG. 1. Right perinephritic abscess. Roentgenograms taken pre- and postoperatively. There is an absence of the psoas muscle shadow on the right in both. The muscle shadow is distinct on the left.

Many times the clinical diagnosis of perinephritic abscess is simple without the roentgenogram. Frequently, the changes that are possible are observed on the roentgenogram much earlier than may be ob-

* From the Genitourinary and Roentgen Departments, Sinai Hospital, Baltimore. Read before the Eastern Conference of Radiologists, Baltimore, January 31, 1936.

FIG. 2. Right perinephritic abscess. Roentgenograms taken pre- and postoperatively. There is an absence of the psoas muscle shadow on the right in both, while the shadow of the muscle is very distinct on the opposite side, particularly in the postoperative one. Definite curvature of the spine is observed with the concavity on the opposite side of the lesion.

served otherwise; this is not so true in perinephritis but is certainly so in perinephritic abscess. The early diagnosis can therefore be materially aided by the changes observed on the plain film. Only too often some of these cases are pyelographed and demonstrate normal ureteropyelograms with the result that a urological condition is overlooked.

There are two types of perinephritic abscess observed: the metastatic type and the non-metastatic type associated with some urological condition.

In the first group there is a distant focus

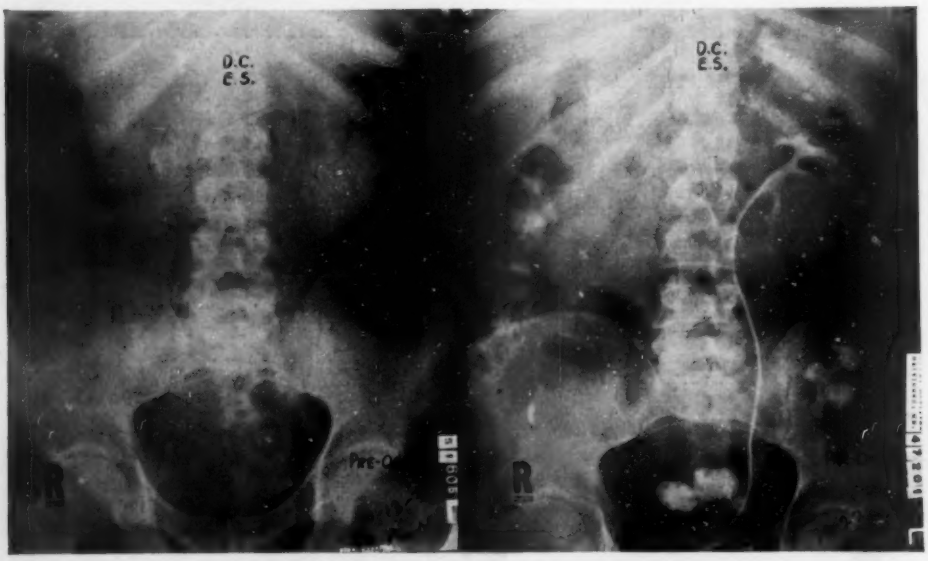


FIG. 3. Left perinephritic abscess with perinephritis. Plain roentgenogram and pyelogram. The plain film shows an absence of the psoas muscle shadow on the left and the pyelogram demonstrates a similar picture. It also demonstrates some involvement of the kidney.

of infection which is transmitted by the blood or lymph stream to the kidney cortex and then to the perinephric tissues. In some few cases of this type the kidney may not be involved, but for the most part the kidney is involved. The other group travels by way of the lymph stream or by continuity of tissue from the site of the lesion.

It is in the latter group that the diagnosis is simple from a clinical standpoint because in most instances pus and organisms are found in the urine.

In the former group the diagnosis is considerably more difficult because of the absence of pus in the urine in the majority of cases. Even in this group, while there is a cortical lesion present in most instances, no pus, but organisms are found in the urine.

Due to the fact that the lesion is cortical, a ureteropyelogram is negative except if the cortical lesion has involved the parenchyma of the kidney.

We have had an opportunity of studying 21 cases of perinephritic abscess, 10 of which have occurred in the past two years. We have become very conscious of the condition and therefore are extremely careful in the interpretation of the roentgenogram.

Fig. 4. Left perinephritic abscess. Postoperative pyelogram of previous case. The psoas muscle shadow is not visible on the left, but the outline of the pyelogram demonstrates a distinct return of the normal outline.

Of these 21 cases, 19 were diagnosed as perinephritic abscess, 17 of which came to operation or autopsy and were verified. In the other 2 that were diagnosed as such, the condition subsided clinically and the patients left the hospital without opera-

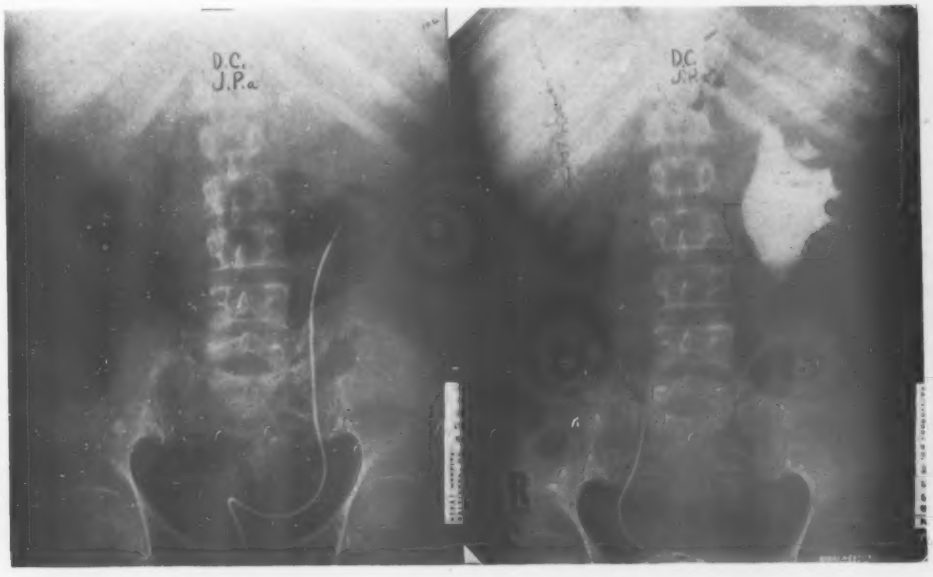


Fig. 5. Left perinephritic abscess. There is an absence of psoas muscle shadow on the left in both the plain roentgenogram and the pyelogram. The shadow of the muscle is visible on the right. Slight concavity of spine on the right which is on the opposite side of the lesion.

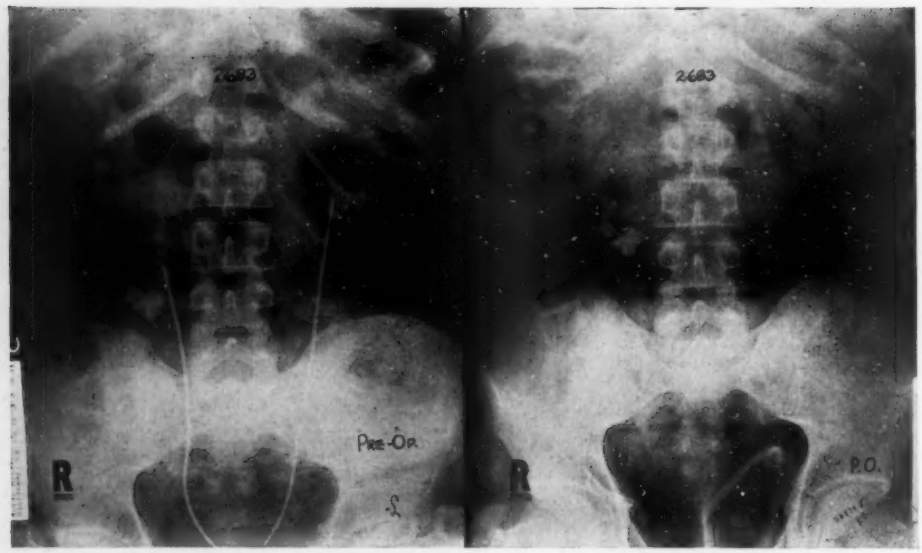


FIG. 6. Right perinephritis with renal calculi. There is an absence of the psoas muscle shadow on the right in both the pre- and postoperative roentgenograms. The shadow of the psoas muscle is visible on the left.

tion. The other 2 undiagnosed cases occurred as far back as ten years ago when we were not quite as careful in the diagnosis as we are today. Of the 19 cases diagnosed as such we had an opportunity of studying 15 of them with the roentgenogram.

We shall therefore confine our discussion to these 15 cases where roentgenographic studies were possible. In these 15 cases studied roentgenographically, all demonstrated some changes as mentioned before that may be found when a plain roentgenogram is made. For the most part, the important observations were made in the shadows of the psoas muscle and the lumbar spine.

FIG. 7. Left perinephritic abscess. Roentgenogram shows absence of shadow of psoas muscle on the left with a distinct vision of it on the right.

In all 15 cases that were roentgenographed there was constant obliteration, either wholly or partly, of the psoas muscle shadow. In most instances the entire shadow was obliterated, but it is possible to have the shadow of the muscle only partially obliterated, depending upon the location of the abscess.

Twelve of these 15 cases demonstrated definitely a curvature of the lumbar spine with the concavity on the side of the abscess in 11 and the concavity away from the side of the lesion in 1 case. Not having had control roentgenograms of these cases prior to their infection, it is difficult to state whether the abscess caused the curvature or whether the curvature was present prior to the appearance of the abscess. Nevertheless it was such a constant feature that serious consideration should be given to its presence when a lesion suspicious of abscess is thought of.

In the consideration of both of these diagnostic features it is of extreme impor-

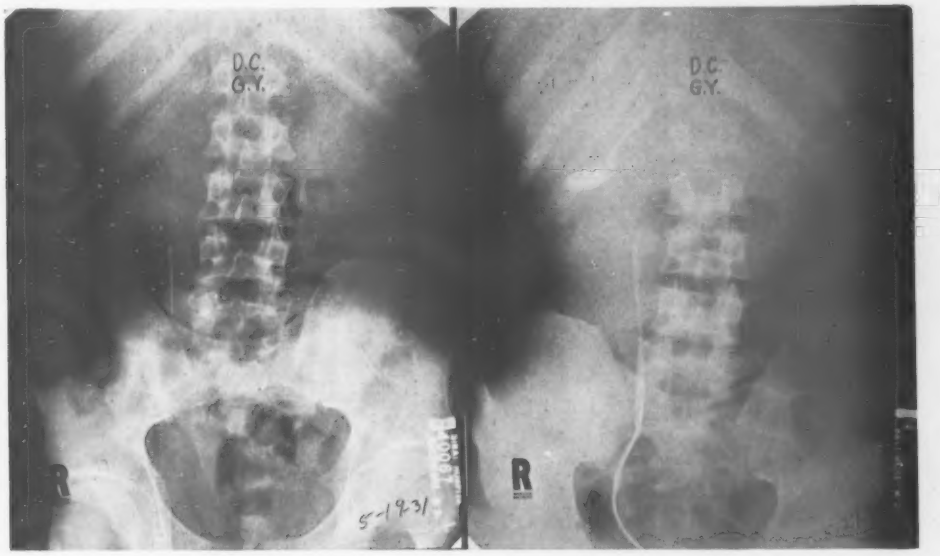


Fig. 8. Right perinephritic abscess. There is an absence of psoas muscle shadow on the right in both the plain and pyelographic films. The psoas muscle shadow is seen on the left. The pyelogram demonstrates involvement of the right kidney. There is complete obliteration of kidney shadow.

tance to see that the patient is lying straight and has no artificial scoliosis, and that a clear view is obtained in the roentgenogram. In a study of the psoas muscle shadow, comparisons can be made with the opposite side, also repeating the roentgenogram.

If the shadow is obliterated on one side and not on the other, providing all things are equal, suspicion should be aroused as to the presence of a lesion such as an abscess.

The presence of gas in the colon will frequently obliterate the shadow of the muscle, making it impossible for a correct interpretation. The films should then be repeated for verification.

No special technique has been employed in the taking of the film.

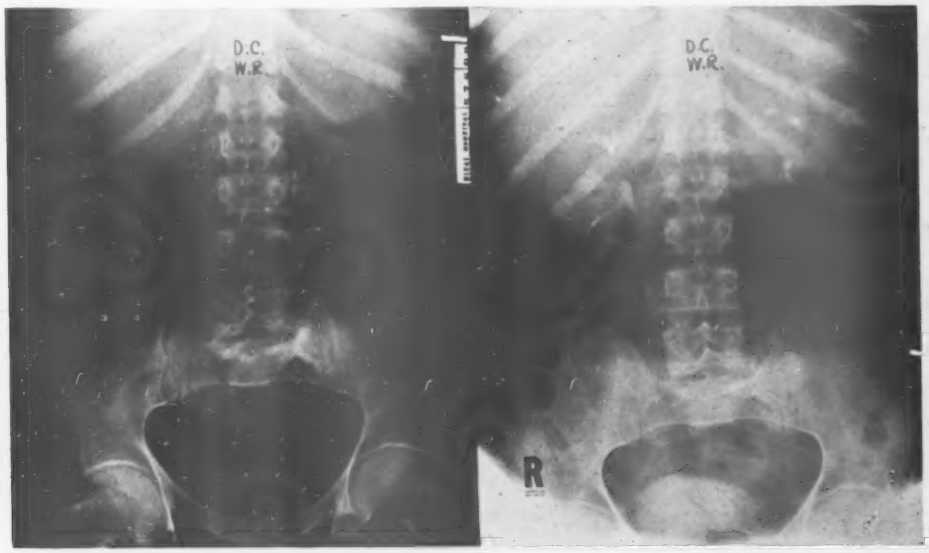


Fig. 9. No perinephritic abscess. Psoas muscle shadows are seen on both sides in the plain and pyelographic films. Diagnosis was that no abscess was present. Operation performed and no abscess found.

The obliteration of the kidney shadow cannot in itself be depended upon, but in association with the other observations it may be of some assistance in the diagnosis. The larger the abscess, the more likely the obliteration of the renal shadow. The same is true if the abscess is completely surrounding the kidney or, if the abscess is posterior rather than anterior.

Similar statements can be made regarding the fixation of the kidney shadow in the horizontal and erect posture, also in the obliteration of the shadow of one or more transverse processes. These latter points in themselves would not be pathognomonic of an abscess, but the observation of these two points should arouse suspicion in the light of other data.

Ureteropyelograms were made in several cases and only in advanced cases did they elicit any information. In several instances where the ureteropyelogram was made, it was principally performed for differential diagnosis. Assistance in the diagnosis was rendered in several instances when a ureteropyelogram was made. It frequently gave information as to whether a definite renal lesion was associated with the abscess. The routine has been not to make a pyelogram except for differential diagnosis. Even then, it may not be the best procedure because these patients as a rule are in a weakened condition and may have a severe reaction. In addition, some little bleeding may result with the possibility that some organisms may enter the blood stream and cause a more serious condition.

A postoperative roentgenogram was made in only 3 cases. In these cases the shadow of the muscle was still obliterated.

The question of differential diagnosis between perinephritic abscess and psoas abscess should not cause great concern, because in either case it is an abscess and similar changes will be found in both.

A stereoscopic study should be made wherever possible as it will assist in differentiating an abscess from other conditions as well as differentiating a perinephritic abscess from an abscess in the same plane but not around the kidney. An abscess in the same plane will produce the same changes roentgenographically. Where other pathology is present such as a tumor, calculi, etc., the shadow of the psoas muscle may be obliterated but may be diagnostic of perinephritis rather than abscess.

## CONCLUSIONS

1. Fifteen cases of perinephritic abscess were studied roentgenographically and in all a diagnosis of a suspicious perinephritic abscess was made. All were verified at operation or autopsy.

2. In all the fifteen cases a constant feature was obliteration of the psoas muscle on the side of the disease, with the presence of some scoliosis of the lumbar spine (12 cases).

3. Obliteration of the renal shadow was observed in five cases and obliteration of the transverse process in two cases.

4. The fixation of the kidney shadow was insufficiently studied in these cases for conclusions to be drawn.

5. Repeated roentgenograms should be made when necessary if the psoas muscle shadow is obliterated.

6. The psoas muscle shadow did not return after operation in three cases that were studied up to three months after operation. This observation should be studied.

7. No case of bilateral obliteration of the psoas muscle was observed in this study.

8. No case of bilateral perinephritic abscess was found.

9. No case of perinephritic abscess was found where the psoas muscle shadows were not obliterated and the patient operated upon.

10. A stereoscopic study will assist materially in differential diagnosis of other conditions in the same plane, as well as abscesses.

# PRIMARY CANCER OF THE DUODENUM

## REPORT OF CASE

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PRIMARY cancer of the duodenum is relatively infrequent, constituting approximately 0.25 per cent of all carcinomas, and about 3 per cent of intestinal carcinomas (Mateer and Hartman). It is rarely suspected and seldom diagnosed, and for these reasons the following case report is submitted.

J. T., a white male, aged sixty-nine, tailor, was first seen in the out-patient department of Grasslands County Hospital, August 14, 1934. He was born in Poland. Has lived in the United States for past thirty years. Wife and four children living and well.

*Present Illness.* Patient complained of weakness, epigastric distress, nausea and vomiting at irregular intervals following meals. The duration of these complaints was approximately eleven weeks, with marked aggravation in the past two weeks. He also gave a history of cough for the past two years, with production of a small amount of yellowish sputum. He denied hemoptysis, chills, fever, night sweats, but has lost 15 pounds in weight in the past ten weeks. On August 17, he returned to the clinic, at which time a severe secondary anemia was noted with 10 per cent nucleated cells. On August 20, the patient was sent to the roentgen department with a clinical diagnosis of bronchiectasis and gastric cancer. Roentgen examination of the chest revealed a fibroid tuberculosis of both upper lobes. A gastrointestinal roentgen examination demonstrated a diverticulum of the third portion of the duodenum (Fig. 1). The stomach was normal, the duodenum showed no obstruction, but the second portion was constantly widened, and the normal transverse markings were absent (Figs. 2 and 3). The liver was considerably enlarged, and the spleen to a lesser degree. He was admitted to the Hospital, and the physical examination revealed a well developed, but very thin, poorly nourished, very anemic male, who appeared chronically ill. The temperature was 99.6° F., pulse 118, respiration 24, blood pressure 130/68. There was an occasional cough. He did not complain of pain. Skin yellowish-green color. The thorax was phthisical in type, clavicles prominent with marked hollowing in

FIG. 1. Tracing of roentgenograms showing loss of normal contour of second portion of duodenum and diverticulum in third portion.

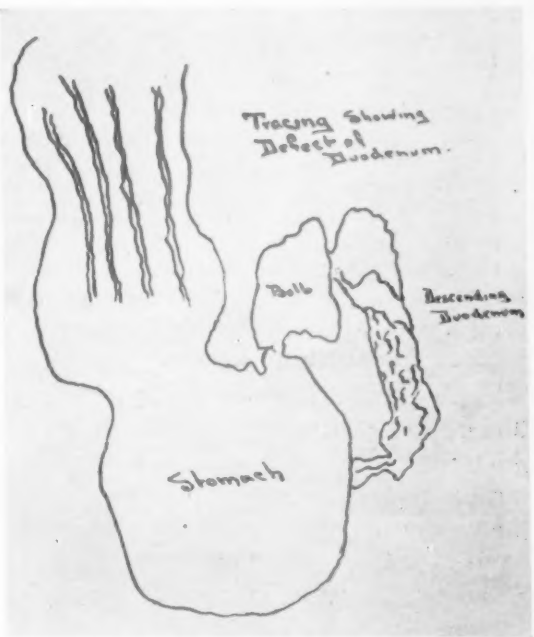


FIG. 2. Tracing of stomach and duodenum showing widening and abnormal contour of second portion.

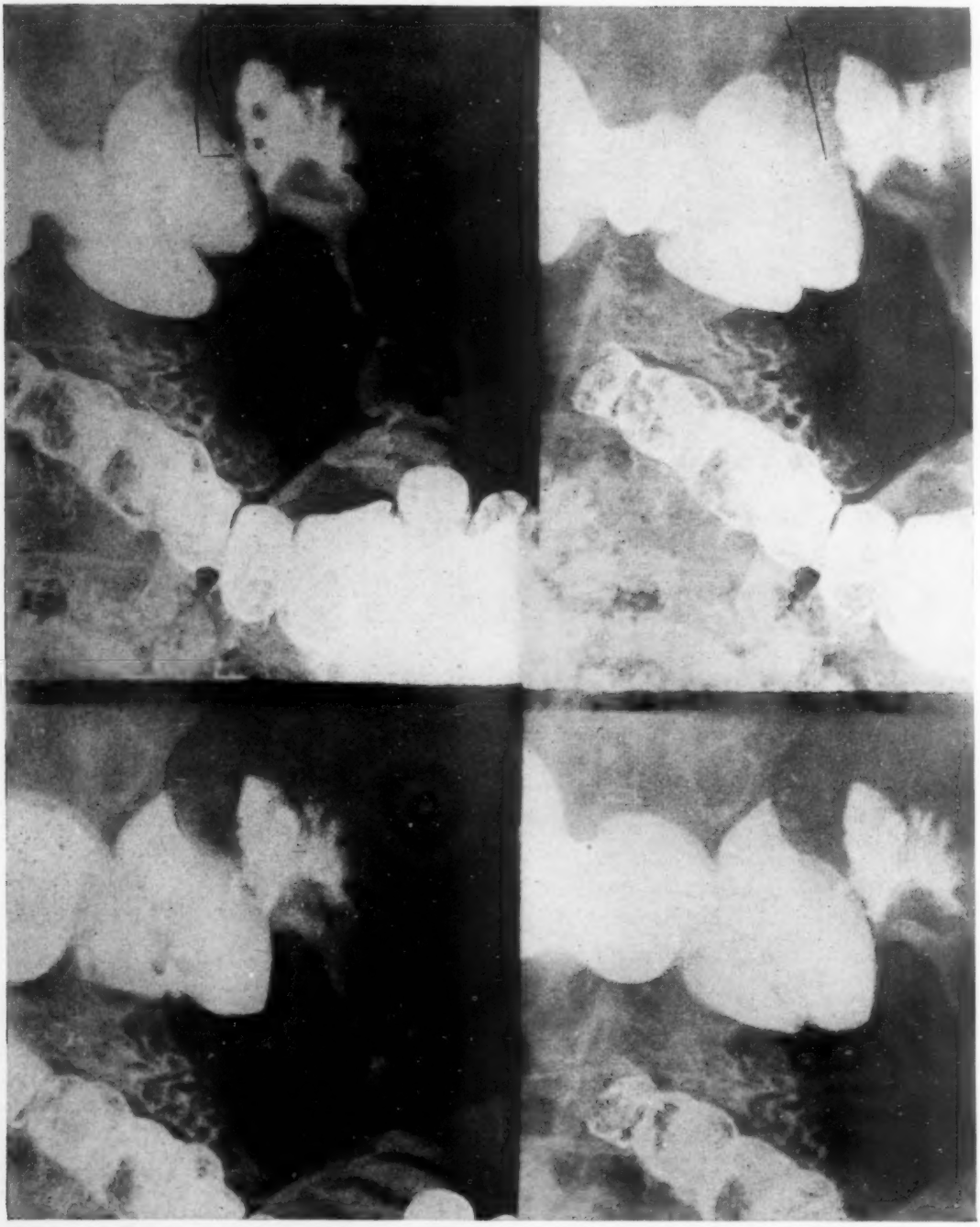

FIG. 3. A multigram showing constant widening of duodenum with loss of normal markings.

supraclavicular fossae. There was dullness of the left lung above the fifth dorsal vertebra posteriorly, and above the third dorsal on the right many râles were present. Heart was negative. The abdomen was moderately rigid, and palpation was difficult. No areas of tenderness were present, and no masses were felt.

*Laboratory Findings.* Blood showed marked secondary anemia; red blood cells, 2,550,000; Hb, 35 per cent; white blood cells, 11,800–14,800. Urine heavily bile stained, albumin 2+, no blood or casts, sputum was always positive for tubercle bacilli, with Gaffke count of 7. Feces showed occult blood practically constant.

Icteric index 28; blood chemistry normal; Wassermann reaction negative.

*Course.* This was progressively down-hill. His jaundice increased with light colored stools, and bile stained urine. Rigidity of the upper abdomen was constantly present, and there was enlargement of the liver with marked tenderness during percussion. Cachexia and anorexia became progressively more pronounced, and the patient died October 10. Duration of the illness from the onset of abdominal symptoms was four months.

*Post-Mortem Examination. Lungs:* Dense fibrotic tuberculous lesions in both apices and in the upper portion of the right lower lobe. In the left lung a cavity 2 cm. in diameter was present. The bronchial tree showed areas of ulcerated mucosa, and the hilar nodes, caseous areas. *Abdomen:* Inspection of the upper abdomen showed a hugely distended gallbladder and common duct, and a mass in the first and second portions of the duodenum. On opening this latter organ, a polypoid mass was found projecting up from the ampulla of Vater and occupying most of the duodenal lumen. The ampulla was destroyed. The mass was friable, cauliflower like in structure, and soft in consistency. The surface of the mass was 7 × 6 cm., it was flat and not more than 1 cm. in thickness except at the ampulla, where it penetrated for another 0.5 cm. The duodenum proximal to the mass was dilated, and the wall somewhat hypertrophic. *Liver:* Was tremendously enlarged, deep green in color, and showed numerous infected and dilated biliary passages containing a thick yellowish puriform material. *Biliary Ducts:* The hepatic, cystic and common ducts, as well as the gallbladder, were greatly distended, the latter containing 150 cc. of thick black bile. *Pancreas:* Was small in size and not involved, the duct was not distended. *Spleen:* Greatly distended by blood. No metastases of the tumor were noted. *Microscopic Examination:* The structure of the tumor is that of a columnar cell adenocarcinoma. The structure is coarse and the acini large and irregular (Fig. 4). Most acini are greatly elongated. The base of the tumor shows invasion of the muscularis of the duodenum, and the deeper portions of the tumor are anaplastic while the superficial parts are distinctly orderly. No local metastases are found.

*Comment.* According to statistics in the recent literature this case of papillary carcinoma of the ampulla of Vater is the most common variety found, and comprises 66 per cent of the duodenal carcinomas. In the 6 cases reported by Mateer and Hartman, 5 were examined roentgenographically, 2 showed a definite filling defect of second part of duodenum, and 1 showed a filling

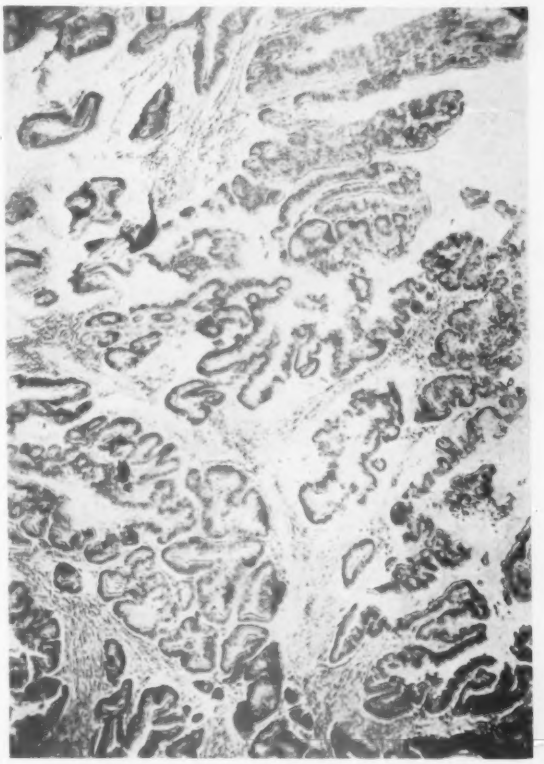

Fig. 4. Reproduction of section of pathologic specimen.

defect of third portion, with retention in stomach and duodenum at six hours. In 4 cases reported by Meyer and Rosenberg the results in 3 were negative. In the fourth the duodenum was not seen because the first portion had been closed surgically. Adding the case reported by Swenson to the above, in only 3 cases of 10 examined, or 30 per cent, was a filling defect demonstrated. Inasmuch as there is an absence of a definite symptom-complex, the difficulty of diagnosis is apparent. The chief complaints are epigastric distress following meals, nausea or vomiting, marked loss of weight, weakness, pallor, and jaundice of greater or lesser degree. While an enlarged

liver and distended gallbladder are noted as common findings at operation or autopsy, it would appear that the enlarged gallbladder is usually not found on physical examination. The most constant laboratory findings are occult blood, high icteric index, and pronounced secondary anemia.

It would seem that the emphasis placed on the rarity of this lesion tends to exclude it from consideration, and attention is focussed on the following possibilities: gastric malignancy, pre- or postpyloric ulcer, malignant degeneration on an old ulcer base, malignant infiltration of gallbladder or ducts. While roentgengraphic examination serves to eliminate the pre- and postpyloric ulcers, and gastric malignancy, the demonstration of malignancy in the duodenum is difficult due to the rapid passage of the barium, and the visualization of only a small portion of this structure at any one time.

The presence of occult blood is one of the most common findings. In the present case pulmonary tuberculosis with cavitation was present, and, in addition, a diverticulum of the third portion of the duodenum near the angle of Treitz.

While primary carcinoma of the duodenum is not frequent, a sufficient number of proved cases have been reported to necessitate its consideration in the presence of occult blood, secondary anemia, and high icteric index in a patient giving a history of comparatively recent epigastric distress, nausea and vomiting, and pronounced loss of weight.

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Vol. 40, No. 3

# CARCINOMA IN A CASE OF ESOPHAGEAL HIATUS HERNIA*

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THE following case report is submitted because of the rarity of a neoplasm in a hiatus hernia. The case was correctly diagnosed ante mortem, and roentgen therapy given in an unsuccessful effort to palliate the disease.

A salesman, aged sixty-five, entered on the service of Dr. Middleton on May 19, 1936, complaining of weakness, loss of 66 pounds in nine months, fatigability, dizziness, and loss of appetite. There was a gnawing abdominal pain localized to the left of the umbilicus, relieved by milk or food. He could not swallow solids, and he had to wait for liquids to go down. He vomited a little slime in the mornings. No hematemesis or melena had occurred.

On physical examination the only significant observations were slight hepatic enlargement and general pallor.

*Laboratory Examination.* Blood, Hb., 35 per cent, red blood cells 2.1 million, white blood cells 12,500; gastric contents, 52° free acid. Roentgen examination (Dr. L. W. Paul) showed an irregular filling defect involving the cardio-esophageal area, most of the deformity being in a supradiaphragmatic pouch of the stomach. Diagnosis: Carcinoma of the cardio-esophageal area in an esophageal hiatus hernia (Fig. 1).

FIG. 1. Roentgenogram of the lesion, September, 1936. The appearance was essentially the same as on the original examination.

FIG. 2. Specimen removed at autopsy.

*Course.* The patient was given 2,000 r (in air) to the anterior and posterior epigastric regions in 10 treatments from June 16 to June 27, 1936, and another 1,600 r (in air) from September 9, to September 18, 1936 in 8 treatments. The factors were 175 kv., 15 ma., 50 cm. focal skin distance, 1 mm. Cu and 1 mm. Al, 7½ min., 200 r (in air) per treatment. While some clinical improvement was found after the first course of treatments, there was no change in the appearance of the roentgenograms. Metastases were found in the thoracic spine. After the second course of treatment the patient went downhill rapidly and died on January 6, 1937.

Post-mortem examination (Drs. C. H. Bunting and G. Ritchie) showed a fungating growth

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10 cm. in diameter (microscopically adenocarcinoma) encircling the lumen of the cardia of the stomach and extending into the esophagus (Fig. 2). The stomach was herniated through the diaphragm. The other findings had no bearing.

The unusual coincidence of a carcinoma in an esophageal hiatus hernia has previously been reported seven times in the literature.[3] However, as some of these reports are fragmentary, no analysis of the cases is possible. One previous case was correctly diagnosed by roentgen ray ante mortem.[6] The rarity of the coincidence of these two conditions is perhaps not surprising when one considers the incidence of carcinoma of the cardia of the stomach, and of hiatus hernia, both of which are relatively uncommon.

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# BILATERAL SUBCAPITAL FRACTURES OF THE FEMURS FOLLOWING CARCINOMA* OF THE UTERUS

## CASE REPORT

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SUBCAPITAL fractures of the femur are common and are well discussed in the literature. Whitman,[18] Speed,[14] Cotton,[1] Jones,[7] Gaenslen,[3] and many others, have written articles on this particular type of fracture with excellent studies of the etiology, pathology, treatment and results. It is not my intention to enter into that field of discussion.

Fractures of the femoral neck in patients with metastases from carcinoma have been repeatedly described. Most of these reports have concerned individuals with metastases from carcinoma of organs other than the uterus. The distribution of bone metastases from uterine carcinoma has been described by McWhorter,[9] Primrose,[12] Kinney,[8] Rosh,[13] Sutherland, Decker and Cilley,[15] Ford,[2] Jeaneny,[5] Monad,[10] and others. It is quite generally conceded by these authors that bone metastases from uterine carcinoma are far less common than from mammary and prostatic carcinoma. A relatively small number of cases showing metastases in the femur from uterine carcinoma has been reported.

Bilateral fractures of the femurs have been described by several authors. Hübner[4] reported such fractures in an adult male who had had a severe blow to the back while standing with his legs widely abducted. Myers[11] described an unusual case in a young man whose fractures had occurred in infancy. Johnson[6] reported bilateral fractures of the femoral shafts following severe trauma. Whitbeck[17] described bilateral fractures of the femoral necks in a young child. Von Nürenberg[16] reported bilateral fractures of the femoral necks in a young mother with marked osteomalacia. Undoubtedly there have been other similar reports.

This particular case is being reported for the following reasons: Metastases to the femurs from uterine carcinoma are not common. Bilateral femoral neck fractures occurring within a relatively short period of time, and without severe trauma, are relatively rare. This patient had a proved carcinoma of the uterus and improved following radium and roentgen therapy. The symptoms of the carcinoma disappeared. She had a roentgenogram of the bony pelvis that revealed no evidence of metastases or bone change. Within six months she developed fractures of each femoral neck in the same relative position, without severe trauma.

### CASE REPORT

P. R., aged sixty-nine, first entered this hospital on May 6, 1936, with complaints of vaginal bleeding, weakness, and lower abdominal discomfort. The bleeding began with a slight spotting several months previous to her entry here. The amount of this bleeding gradually increased during that time, and she finally consulted a physician. He advised immediate hospitalization for diagnosis and treatment.

Her menstrual history was as follows. Her periods began when she was fifteen years of age. They were quite regular, lasted two to four days and were not accompanied by much discomfort. She had 7 children, and all deliveries were normal. She had no miscarriages or still births. She reached the menopause at the age of forty-nine, and except for a slight leukorrhea, she had no vaginal discharge until the recent bleeding.

Her past history was essentially negative except for childhood diseases with good recovery. She denied any venereal infection.

The physical examination revealed a small elderly woman with no abnormalities except for

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Fig. 1. Pelvis as it appeared four months after roentgen therapy, and before fractures occurred.

erosion of the cervix uteri and external hemorrhoids. The laboratory examination revealed a mild secondary anemia, slight amounts of blood and pus in the urine, and good kidney function.

A biopsy from the uterine cervix revealed the presence of squamous cell carinoma, Grade 2. Radium was inserted into the uterine canal, and a total of 3,000 mg-hr. of radium therapy was given. This was followed by a series of daily roentgen treatments. The factors used in these treatments were: 200 kv. (peak), 15 ma., 55 cm. skin target distance, Thoraeus filtration (equivalent to 1 mm. Al, and 0.5 mm. Cu), and a 15 by 15 cm. field. The treatments were given over the pelvis through two anterior and two posterior portals. Because of the extreme nervousness of the patient, only one portal was treated each day. The treatments were continued until a total of 1,500 r had been given over each portal.

For two weeks following the roentgen treatments, she had some nausea, and a little vaginal bleeding. These disappeared, and she gained in strength and weight. The skin over her pelvis was somewhat tanned but of good texture. She was able to be up and about her home.

She returned to this department on September 28, 1936, with complaints of pain in the lower back, pelvis and hips. A roentgenogram, made at that time, revealed no evidence of metastases or other bone pathology (Fig. 1). I was out of the city at the time, and the roentgenologist present did not feel it advisable to give further roentgen therapy for her pain.

She returned to her home and continued to complain of the pain. In January, 1937, she began to complain of the pain being more acute in the region of the right hip joint. She had not had any specific injury to this hip, but the pain seemed to persist there. In February, 1937—the exact date was not remembered—she slipped on a rug and slid to the floor slowly. She felt no severe twist or blow to her hip, but was unable to get up and complained bitterly of pain in the left hip. She was unable to bear weight on the left leg when helped to the erect position. Still she did not think she had fractured her hip, and refused medical care.

This patient returned on March 24, 1937, for a roentgenogram of the bony pelvis and hips (Fig. 2). This revealed the bilateral subcapital fractures of the femurs. The fragments on the right were impacted in fair position and alignment. We interpreted this as the primary fracture, with some evidence of healing. The fragments on the left were not in good position or alignment, and very little impaction was present. There was some shortening and external rotation of the shaft fragment. This we interpreted as the secondary fracture which had probably occurred in February. There was no definite evidence of healing about these fragments. The femoral heads were both viable.

An attempt to improve the position of the fragments of the left femur by adhesive plaster and weight traction was unsuccessful, as revealed in the roentgenograms made at that time (Fig. 3). It was then decided to reduce the left fracture under anesthesia, and place this pa-

Fig. 2. Pelvis and hips showing bilateral subcapital fractures of the femurs, occurring within six months after roentgenogram shown in Figure 1.

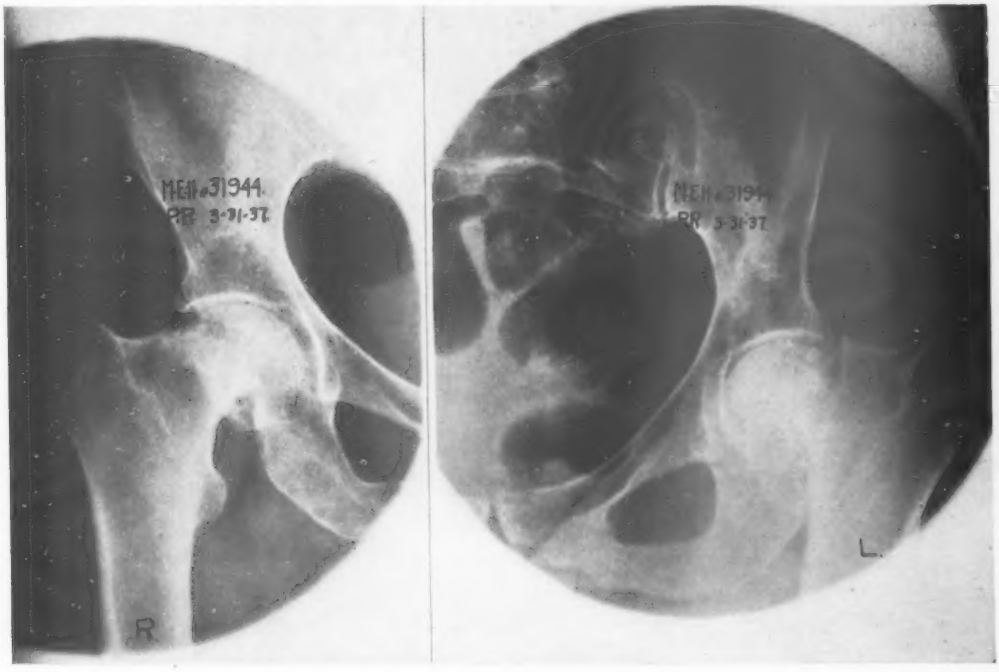


Fig. 3. Detail views of each hip joint.

tient in a double hip spica cast. This cast was extended to the toes on each side. A portion of the cast over the left hip was later removed, and roentgen therapy over this hip joint was carried out.

## CONCLUSIONS

1. Bone metastases from uterine carcinoma are uncommon.

2. Bilateral fractures of the femoral neck are rare. I have found no report in the literature of bilateral subcapital fractures of the femoral neck.

3. A case presenting a known carcinoma of the uterus followed within six months by bilateral subcapital fractures of the femoral neck without severe trauma, and with some evidence pointing toward metastases, has been presented.

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# THE ROENTGENOGRAPHIC DIAGNOSIS OF VITAL PULP INFECTION AS CONFIRMED BY BACTERIOLOGICAL EXAMINATION

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THE increasing importance of accuracy in dental diagnosis is well reflected in recent literature. The relationship of dental foci such as acute or chronic periapical abscesses, pyorrhea, or chronic periapical infections of pulpless teeth to the manifestations of focal infection is well understood. For practical purposes these can be considered as primary septic foci and their removal is attended with restoration of health to the individual, providing no secondary foci have become established with the same offending microorganism which might remain dominant in their pathogenicity for that particular host. This study of vital pulp infection was made to determine the relationship of this focus to the chronic infectious state. In the latter case it is only occasionally that the patient is benefited by the removal of a single septic focus; this having failed, another focus is removed and so on, until eventually all accessible foci have been extirpated; unfortunately, too often the patient has not obtained the desired results.

This sequence of events is a constantly recurring problem to the internist. The basic mechanisms involved in the production of symptoms in systemic disease are not yet understood. Antibacterial immunization appears to be the method of choice in the therapeutic armamentarium.

Success in attacking the problem of chronic systemic disease on the basis of immunology is dependent upon uncovering all foci of infection and their bacterial habitat, the correlation of these findings to the physical picture and the exercise of good judgment in determining their relative importance.

Unfortunately, there are no characteristic signs or symptoms from the vital tooth with an infected pulp; indeed the diagnosis is usually debatable. Pain is rarely produced. Inspection of the gingivae and pharyngeal tissues practically always reveals a moderate inflammatory reaction resulting from coexisting upper respiratory infection. Physical findings such as cavities, occlusal defects and motility tests are not dependable criteria. Vitality tests are normal since the nerve is not destroyed in the early or moderately advanced case.

From gross examination of infected pulp tissue it would appear that the process is vascular in origin; the invading organisms are probably deposited by the blood stream and a slow process of vascular degeneration follows, the nerve remaining unaffected until the destruction is complete. All stages of inflammatory reaction have been observed in the pulp tissues examined. The dental roentgenogram offers the most promising diagnostic aid. The value of the examination is dependent upon familiarity with the normal anatomy of the tooth and its surrounding structures and the accurate interpretation of the film shadows. Two parts of the tooth proper are visualized—the outer hard casing of enamel, dentine and cementum which shows density without structure, and the pulp cavity which is radiolucent. The teeth are embedded in the alveolus which has the honeycomb appearance of cancellous bone, it is characterized by a white network enclosing uniformly distributed irregular black spaces. The spaces of this trabeculated network are normally of the same size on both sides in the same individual but vary in different regions of the mouth. The tooth socket in the alveolus is lined by a narrow layer of dense bone known as the lamina dura which roentgenographically appears as a thin even white line surrounding the root of each

tooth and reflected at the neck in a curved line over the interdental alveolus to the adjacent tooth. The teeth are attached to the lamina dura by the periodontal membrane. It appears in the roentgenogram as an even thick black line situated between the lamina dura and the tooth. Interpretation of findings is dependent upon careful technical detail, the variation of angles, and comparison of both sides of the mouth. Frequently composite roentgenographic studies are necessary. It is essential that the apex of the teeth appear in at least one film. If some of the teeth are missing, the alveolus in this area must be included. Buried root remnants should be searched for.

Inflammatory reactions within the pulp tissue cannot be seen in the roentgenogram since the pulp tissue itself is not visualized; they can, however, be interpreted by changes occurring at the apex of the tooth even before signs of alveolar absorption are noted. Such changes in general

Fig. 1. Normal. The periodontal membrane shows as a space between the tooth and the lamina dura.

Fig. 2. There is little change in the cancellous bone structure. Both pericemental membranes are thickened and their continuity broken at the apex, indicating early degenerative changes within the pulp.

are manifested roentgenographically by thickening and broken continuity of the lamina dura and periodontal membranes, retraction at the alveolar margin and by changes in the cancellous bone structure as noted in the detail of the trabeculae and the size of the spaces enclosed. Alveolar absorption is recognized roentgenographically by the absence of the white network.

Variations of roentgenographic density are of little diagnostic significance in the individual film since such variations are frequently found in normal bone and may often occur with variations in technique. Granulomas, abscesses, scar bone, occlusal strain and many other conditions can produce these changes; these conditions do not come within the scope of this paper, but must, of course, be taken into consideration in the question of differentiation.

Decalcification, however, can result from a local cause and be limited to the surrounding bone. When generalized decalcification of the skeletal system exists it is reasonable to assume that some profound constitutional disturbance is the cause, among the many of which may be systemic toxemias of bacterial origin, dyscrasias of the thyroid or parathyroid, deficiency diseases, osteomalacia, senility and diseases of metabolic origin in general being elimi-

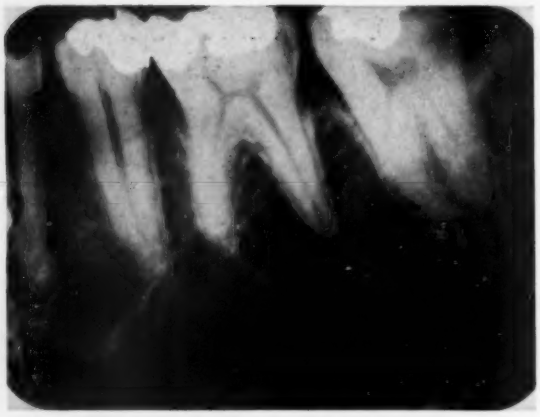

FIG. 3. Normal pericemental membranes and cancellous bone. The abscess of the trabeculated nework is bilateral.

nated. The finding of disturbed apical pericemental membranes in the presence of decalcification, whether general or local, no matter how slight, is evidence of pulp infection. This has been found to be particularly true of the patient presenting the symptomatology of the infectious arthritic state. That the roentgenographic appearance is not typical of one specific condition is well demonstrated when one attempts to distinguish the changes produced by the mechanical traumatism of faulty occlusion and impacted teeth. Here the roentgenogram must be used in conjunction with the history, clinical symptoms and physical examination. Extraction of a suspected tooth for bacteriological examination we believe is indicated when confronted with this problem in the face of a systemic toxemia of probable bacterial origin. This is well exemplified in the following case of a young woman in whom impactions of the third molar were found in both lower molar areas with a history of systemic involvement of eight years' duration substantiated by physical examination. The symptoms were primarily those of cardiorespiratory distress. The dental roentgenograms are shown in Figure 5. There was a coexisting right maxillary sinusitis involving the mucoperiosteum of the antrum. Pulp cultures from the left lower third molar were negative, those from the upper right second molar and lower third molar revealed a type micro-aerophile alpha prime hemolytic streptococcus. Type alpha prime hemolytic streptococci were found in the antrum, cervix and colon. It was concluded that the changes in the left side resulted from traumatism only, whereas the traumatism in the lower right area provided a fertile field for the invasion of a neighboring pathogenic microorganism. The mech-

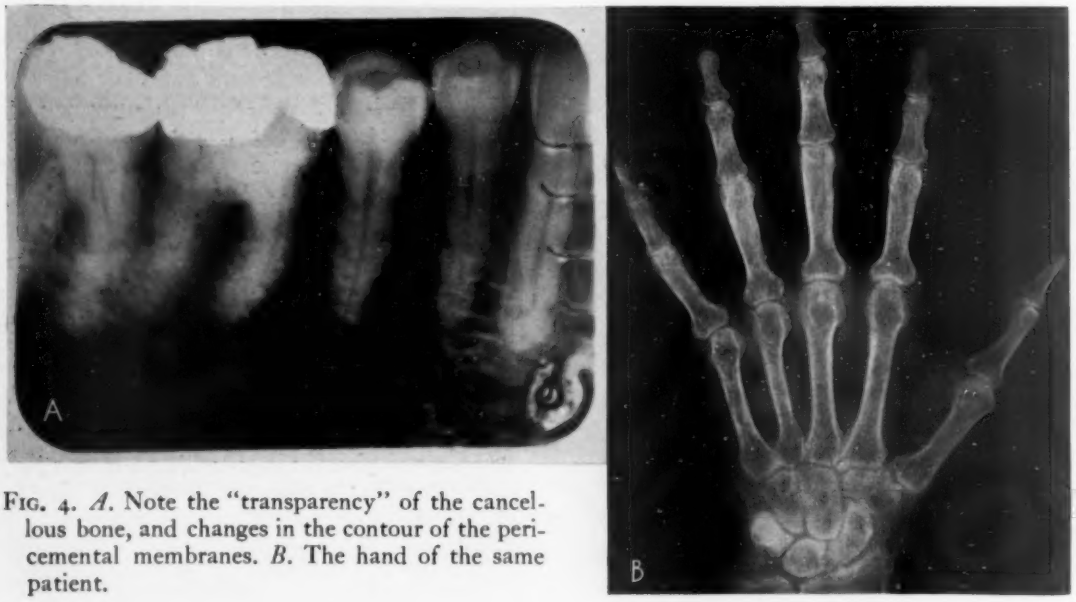


FIG. 4. *A*. Note the "transparency" of the cancellous bone, and changes in the contour of the pericemental membranes. *B*. The hand of the same patient.

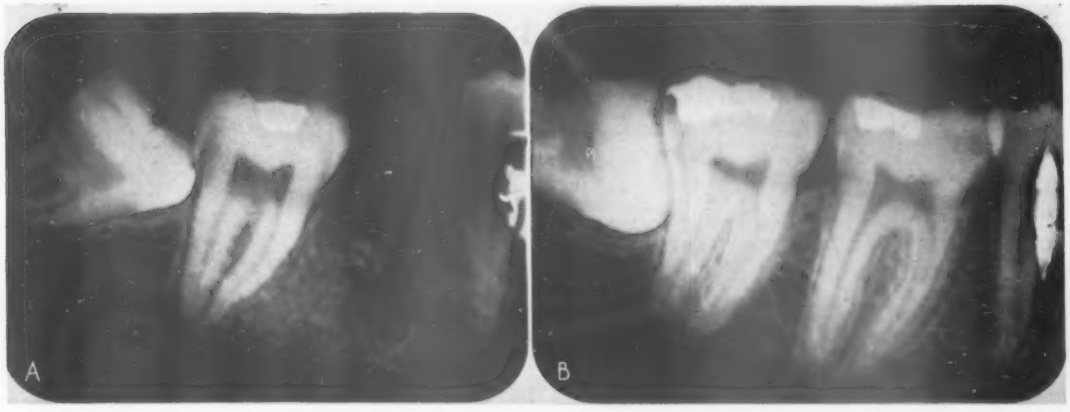


Fig. 5. The pericemental membranes are markedly thickened in *A*, with comparatively little involvement of the alveolar tissue as compared with *B*.

anism of invasion might well be questioned. Whether these foci be metastatic as a result of blood or lymphatic direct secondary implant, or a result of tissue continuity is of interest. In this case it is conceivable that direct bone continuity afforded the path of invasion via the haversian system, the organisms having found a fertile field in the traumatized alveolar tissue, invaded the pulp cavity and there, through the phenomenon of bacterial dissociation, became converted to the type micro-aerophile. It is now known that bacteria are capable of changing their structure, metabolic activities, specificities and their capacities for infection with considerable ease.

The question of predominant pathogenicity of the organisms isolated from these foci is debatable. In our experience the clinical course of the patient's recovery soon answers the question. We do consider these foci as having potential dominant pathogenicity. One cannot state that the microorganisms involved are the primary pathogens. It is well known that the presence of bacteria does not indicate infection, nor in chronic focal or systemic infection is the predominance of any bacterium evidence of a relationship between it and the infection. The various serological tests for determining specific pathogenicity as well as intracutaneous tests are unsatisfactory. The use of the pathogen-selective culture utilizing the patient's coagulable blood is unreliable. It would seem that a state of bacterial equilibrium exists between all foci. The clinical relationship of a vital pulp focus is suggested by the following case reports:

Case 1. Male, aged thirty-eight, in whom the history and clinical symptoms suggested a systemic toxemia with predominating gastrointestinal distress of sixteen years' duration. A tonsillectomy and bilateral Caldwell-Luc operation had been done. At intervals the teeth had been examined and regarded as normal. Physical examination revealed numerous foci of chronic infection. The general clinical picture was confirmed by routine laboratory findings. Bacteriologically, type beta hemolytic streptococci were found in the antra, third molar pulp, prostate and colon. In the pulp of the

Fig. 6. Pericemental membranes are thickened and broken. The trabeculated structure of the cancellous bone is varied.

second molar type micro-aerophile alpha hemolytic streptococcus was found. After five months of treatment clinical progress was considered only moderately satisfactory. No gross changes were evident on which a satisfactory prognosis could be established. On re-examination the bacteriological rather than clinical findings appeared to be of greater value. No type beta hemolytic streptococci were recovered. Type micro-aerophile alpha hemolytic streptococci were found in the pulp of the first molar and in the colon. With the finding of these foci and subsequent therapeutic modification recovery progressed uneventfully.

CASE II. Male, aged forty-two, presented an enterorenal symptom-complex complicated with cardiac distress of eleven years' duration. Tonsils, teeth and appendix had been removed. Exploratory laparotomy revealed no pathology. Following physical, roentgenographic and routine laboratory study a diagnosis of systemic toxemia was concluded. Bacteriological examination revealed type alpha hemolytic streptococcus from the antra, prostate and colon. Amelioration of symptoms was prompt and an apparent clinical recovery had been accomplished within eight months. The patient had been discharged for six months when a gradual recurrence of symptoms appeared, the cause of which could not be determined. Complete physical examination, including roentgenographic studies of the alveolar tissue, revealed a root remnant and a diffusely inflamed sigmoid colon as determined by the sigmoidoscope. The root was recovered and included in the bacteriological study. Type gamma streptococcus was found in the pulp and colon. No other pathogenic strains were isolated. Specific therapy from these findings resulted in an uneventful recovery which, after an interval of ten months, seems to be permanent.

Having made a diagnosis of vital pulp infection from roentgenographic examination the tooth is extracted for bacterial

TABLE I

BACTERIOLOGICAL FINDINGS IN 100 CASES OF VITAL PULP INFECTION

| | |
|---|---|
| Micro-aerophile alpha prime hemolytic streptococcus | 16 |
| Micro-aerophile alpha prime hemolytic streptococcus with *Staphylococcus aureus hemolyticus* | 9 |
| Micro-aerophile alpha prime hemolytic streptococcus—Micro-aerophile alpha hemolytic streptococcus | 4 |
| Micro-aerophile alpha prime and beta hemolytic streptococcus with *Staphylococcus aureus hemolyticus* | 2 |
| Micro-aerophile alpha prime—alpha prime hemolytic streptococci with *Staphylococcus aureus hemolyticus* | 5 |
| Micro-aerophile alpha prime hemolytic streptococcus and alpha hemolytic streptococcus | 3 |
| Micro-aerophile alpha prime and beta hemolytic streptococcus | 1 |
| Micro-aerophile alpha hemolytic streptococcus | 11 |
| Micro-aerophile alpha hemolytic streptococcus with *Staphylococcus aureus hemolyticus* | 2 |
| Micro-aerophile alpha hemolytic streptococcus with *Staphylococcus aureus hemolyticus* | 5 |
| Micro-aerophile alpha and alpha hemolytic streptococci with *Staphylococcus aureus hemolyticus* | 2 |
| Micro-aerophile alpha and alpha prime hemolytic streptococci with *Staphylococcus aureus hemolyticus* | 1 |
| Micro-aerophile gamma streptococcus | 3 |
| Micro-aerophile alpha prime hemolytic and gamma streptococci with *Staphylococcus aureus hemolyticus* | 6 |
| Micro-aerophile gamma streptococcus with *Staphylococcus aureus hemolyticus* | 2 |
| Micro-aerophile beta and alpha hemolytic streptococci with *Staphylococcus aureus hemolyticus* | 2 |
| Micro-aerophile beta hemolytic streptococcus with *Staphylococcus aureus hemolyticus* | 3 |
| Micro-aerophile beta and alpha prime hemolytic streptococci with *Staphylococcus aureus hemolyticus* | 1 |
| Gamma streptococcus | 2 |
| Gamma streptococcus and micro-aerophile alpha hemolytic streptococcus | 1 |
| Gamma streptococcus and alpha hemolytic streptococcus | 2 |
| Alpha hemolytic streptococcus and alpha prime hemolytic streptococcus | 7 |
| Alpha prime hemolytic and beta hemolytic streptococci | 1 |
| Alpha hemolytic streptococci | 1 |
| Alpha prime hemolytic streptococcus | 3 |
| *Staphylococcus aureus hemolyticus* | 4 |
| Beta hemolytic streptococcus | 1 |

It is of note than in 86 per cent of these cases a micro-aerophile type organism has been recovered.

confirmation of the diagnosis. Strict surgical technique is followed. A method has been developed whereby the contents of the pulp cavity are aseptically removed, care being taken to avoid contamination from the tooth proper. The tissue is cultured in aerobic and anaerobic media. After twelve hours these are plated out on blood agar plates. Frequently it becomes necessary to use carbon dioxide to promote the growth of the organisms. The isolated strains of pathogenic bacteria are then included in an autogenous hypodermatic antigen. The bacteriological diagnosis and the undenatured bacterial antigens employed in the immunizing program are made by Dr. A. P. Krueger of the Department of Bacteriology of the University of California.

Since employing this additional diagnostic procedure in the examination of the patient presenting chronic systemic disease we have enjoyed increasing therapeutic success. It is not to be inferred that pulp infections in vital teeth are here regarded as primary foci of infection that are alone capable of producing the profound systemic reaction as found in patients presenting the advanced symptoms of the chronic infectious state. It is, however, of importance that this focus be recognized when the plan of treatment of such cases is based upon desensitization and immunization with autogenous antigens. The failure to include the organisms from each focus in such preparations is the probable cause of many of the poor results obtained with these patients.

SUMMARY

1. Chronic infection of vital pulp tissue can be diagnosed from the dental roentgenogram.

2. The basis of roentgenographic interpretation is the recognition of changes in the contour and continuity of the pericemental membranes and variations in the density and structure of the cancellous bone.

3. Roentgenographic diagnosis is confirmed by the extraction of the tooth and a bacteriological study of the pulp tissue.

4. The bacteriological findings in 100 cases of vital pulp infection are reported in tabulated form.

5. The relationship of this focus to systemic disease is discussed and demonstrated in case reports.

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# ROENTGEN DIAGNOSIS OF REDUCIBLE HERNIA*

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DURING a routine roentgenoscopic observation of the gastrointestinal tract, six hours after the ingestion of a barium meal, the patient coughed. A loop of barium-filled ileum was observed to protrude from the lower curve of the small intestines, moving downward and inward for a distance of about 4 cm. It was localized to the region of the internal inguinal ring. The patient had no knowledge of the existence of a hernia, but physical examination now revealed a definite impulse, with crepitation, in the right inguinal canal. The roentgen examination had discovered and located a hernia, giving information as to its nature, extent, and contents. Interested in this chance finding, and appreciating its possibilities, I routinely examined all gastrointestinal patients in this manner and was surprised to find how frequently the phenomenon was observed.

Examining the literature, many references were found in which barium-filled viscera were observed in hernial sacs.[1,10] These, however, were of large size and contained the viscera at the time of examination. There were other references in which evidence of intestinal obstruction secondary to strangulation was seen roentgenographically.[5] The appearance I had noted was described in an excellent article by Laurell.[8] This observer used the sign, not as a method of diagnosis of a previously unknown hernia, but as a verification in cases in which the diagnosis of hernia had been suspected. No references to this phenomenon were found in the American or English literature.

The diagnosis of hernias of large size offers little difficulty. For many years roentgenologists have observed loops of intestine lying within hernial sacs. These may have been reducible, fixed in the sac, or strangulated. The hernia in each instance was a large one, and not readily overlooked by either the patient or the examining physician. There often exist hernial sacs in which there is no intestine at the time of examination. The existence of small or potential hernias may be most difficult to determine. These latter have assumed an added importance since the growth of industrial and preventive medicine, and any procedure which adds to the ease and certainty of diagnosis justifies a report. The condition is of particular importance in the pre-employment examination, and in the examination of obese individuals in whom an interstitial hernia or an incomplete femoral hernia may present no physical signs.[9]

## TECHNIQUE

Roentgenoscopy is the method of choice. When the discovery of hernia is the main object of the examination, the observation is best made about two hours after the ingestion of the usual barium meal. If, at this time, the lowermost coils of intestines on both sides are not well filled, the patient may be re-examined at hourly intervals. The observation may also be made at the usual five- or six-hour examination in the course of a gastrointestinal series, and the observer soon finds himself using it as a routine measure. At this time it is often possible to examine only the right side. Fortunately hernias are more frequent on this side.[3,7,12] The upright position is the best method of procedure, though the supine may also be employed. The patient is instructed to cough or blow his nose.[6] This aids in determining the proper posture for the roentgenograms, for the best demonstration of the lesion. If the hernia fills only on cough, it will be necessary to make the exposure at the height of the cough. In any event two exposures should be made for purposes of comparison: the first with the patient merely suspending respiration, and the second with the patient markedly in-

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creasing his intra-abdominal pressure. The degree of descent of the intestinal loops may thus be estimated. Roentgenograms, however, are less reliable than roentgenoscopy.

### ANATOMICAL LANDMARKS

The common hernial sites may be located roentgenographically as follows: The internal inguinal ring appears to be vertically over the outer portion of the obturator foramen, at about the level of the depression in the femoral head for the insertion of the ligamentum teres. The internal opening of a femoral hernial sac appears over the upper, outer portion of the body of the os pubis. The lower portion of Hesselbach's triangle, through which a direct hernia occurs, appears above the central and mesial portions of the obturator foramen (Fig. 1).

FIG. 1. Roentgenogram showing relationship of the common hernial sites to the roentgenological anatomy of the inguinal region. *I*, internal inguinal ring; *E*, external inguinal ring; *F*, femoral ring; *G*, Gimbernat's ligament; *H*, Hesselbach's triangle; *C*, conjoined tendon; *A*, epigastric vessels; *XXX*, location of direct inguinal hernia; *P-P1*, Poupart's ligament; *R*, outer border of rectus muscle.

### ROENTGEN FINDINGS

For the purpose of this description, it is assumed that the patient is in the act of executing a procedure which markedly increases his intra-abdominal pressure, such as coughing or blowing his nose. It is also assumed that the loops of intestine adjacent to the various openings of the common hernial sites are filled with barium.

1. In the normal individual the intestinal loops descend as a whole, and maintain their relationship to each other (Fig. 1*A*).

2. Should a slight weakness exist in any of the hernial sites, a slight bulge of the adjacent loop of intestine is noted (Fig. 2*B*).

As far as we now know this condition is of little clinical significance, and presents no symptoms. The only physical sign may be a slight impulse on cough or a relaxation of the internal inguinal ring.

3. Should a marked hernia exist, a loop of intestine may be seen to descend for varying distances in the course of the hernia. The amount of descent visible depends upon the degree of the weakness, the size of the sac, and the presence in the sac of radiotransparent structures (Fig. 2*C*).

In the case of indirect inguinal hernia, the loop of intestine descends first downward, and then obliquely downward and inward, toward, or through the external inguinal ring. Physical examination in such cases will usually present a marked impulse or bulge in the inguinal canal, and a feeling of crepitation over the internal inguinal ring. There may or may not be symptoms (Figs. 3 and 4).

If a direct inguinal hernia is present, the bulge will be vertically above the middle of the obturator foramen. It involves a wider segment of the lower curve of the intestines than does the indirect hernia (Fig. 2*E*).

In femoral hernia the protrusion takes place mesially over the outer portion of the body of the pubis (Fig. 2*D*).

4. In relaxation of the pelvic floor in women, the central intestinal loops may be seen to dip deeply on straining. While this condition is best diagnosed by inspection, it is worthy of mention if noted (Fig. 2*F*).

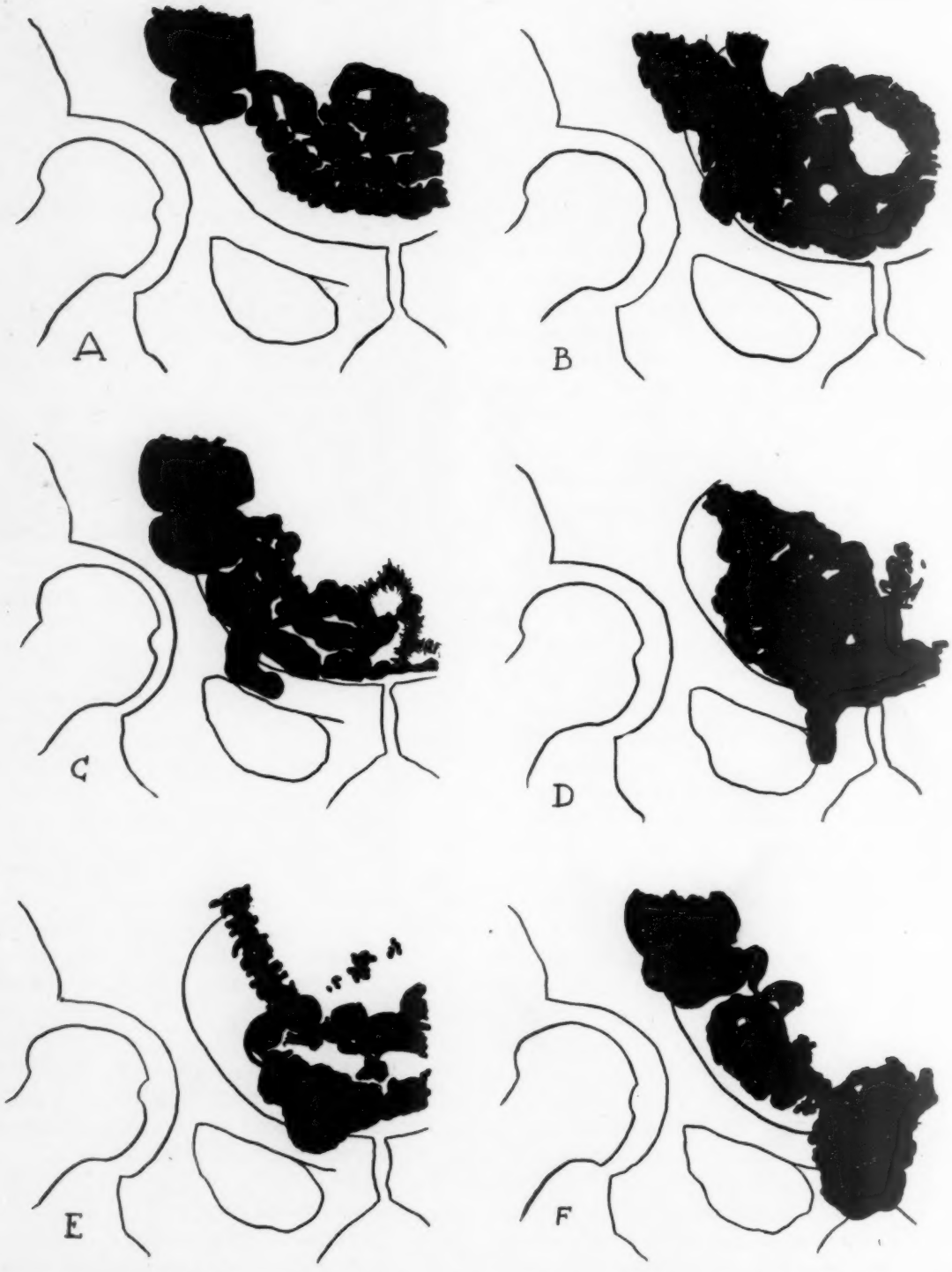


FIG. 2. *A*, normal individual; *B*, weakness of internal inguinal ring; *C*, indirect inguinal hernia, incomplete; *D*, femoral hernia; *E*, direct inguinal hernia; *F*, relaxed female perineum.

Fig. 3. Patient with right indirect inguinal hernia; not straining.

Fig. 4. Same patient, exposure taken during cough. Note the protrusion at the internal inguinal ring.

## COMMENT

A new method of diagnosis of reducible hernia has been described. By this method the present means of diagnosis are complemented and refined, but not supplanted. Many hernias, whose existence had not been previously suspected, may be brought to light, and the differential diagnosis between the various types of hernia, and between this and other conditions, may be rendered easier and more accurate. The routine use of this procedure in the preemployment examination may be the means of avoiding future difficulties both to the employer and the employee.

I wish to express my gratitude to Dr. Nathan Furst, Dr. William Snow, and Dr. Harold Connamacher for their many kind and helpful suggestions.

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# THE VISUALIZATION OF THE AORTA BY THE METHOD OF ROENTGENOGRAPHIC OVERPENETRATION*

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THE aortic knob is the only portion of the aorta well visualized teleroentgenographically. The remainder of the vessel, except for some part of the cephalad portion of the descending thoracic aorta, is obscured by the overlying cardiac and mediastinal opacities, and therefore cannot be distinguished from them on films made with the usual technical factors. A simple method whereby more information concerning the aorta could be obtained from a teleroentgenogram would seem to have its place in the roentgenology of the cardiovascular apparatus.

Roentgenoscopic examination of the central thoracic shadow with a good screen using increased kilovoltage or smaller fluoroscopic fields shows that definite gradations in shadow intensity may be discerned in regions where structures are superimposed. For instance, the border of the thoracic aorta can be seen through the cardiac shadow.

This observation led to the application of the technique of overpenetration, similar in principle to that used in the exploration of pulmonary opacities.[2] In studying the aorta by this method, it is found helpful to visualize the esophagus by means of thick barium paste. In some instances, the dorsal position is used to bring the thoracic aorta closer to the cassette. The roentgenographic technique is altered by increasing the kilovoltage to 85–100, using 100 ma. and one-tenth to three-tenths of a second exposure. Uniform filling of the esophagus is secured by having the patient swallow two teaspoonsful of barium paste about ten seconds apart, and exposing the film five seconds later.

Films made with this technique augment information concerning the heart and aorta derived from routine studies in several details. The outline of the retrocardiac portion of the thoracic aorta, and occasionally the ascending aorta, are better seen. Retrocardiac and aortic calcifications faintly visible or not seen at all on routine films may be visualized. The impression of the transverse aorta on the barium-filled esophagus facilitates the determination of the true diameter of the aorta at that point.[5] However, Zdansky's observation[7] that this measurement is reliable only when the shadow of the aortic rim and its impression on the esophagus form a perfect circle should be kept in mind. Persistence of the right aortic arch causing a left-sided "aortic bed" impression on the esophagus likewise can be detected by this procedure.[1] It would be safe to hazard a guess that the number of diagnoses of this condition might be increased if the barium-filled esophagus were examined with every teleroentgenogram of the heart.

The importance of the position of the esophagus in the diagnosis of left auricular enlargement[4] requires no comment here. However, if the examination is limited to observation of the esophagus in the right anterior oblique projection alone, errors may occur. This is due to the fact that a posterior convexity of the esophagus in the right anterior oblique position simulating an enlarged left auricle may be caused by displacement of the esophagus to the left and posteriorly by a tortuous aorta.[6] Lesser degrees of deviation of the esophagus to the left may render observations made in the right anterior oblique projection alone unreliable because the esophagus may pursue a seemingly straight course in the presence of an enlarged left auricle.

Deviation of the esophagus to the right by an enlarged left auricle is common, although it is possible to have early left

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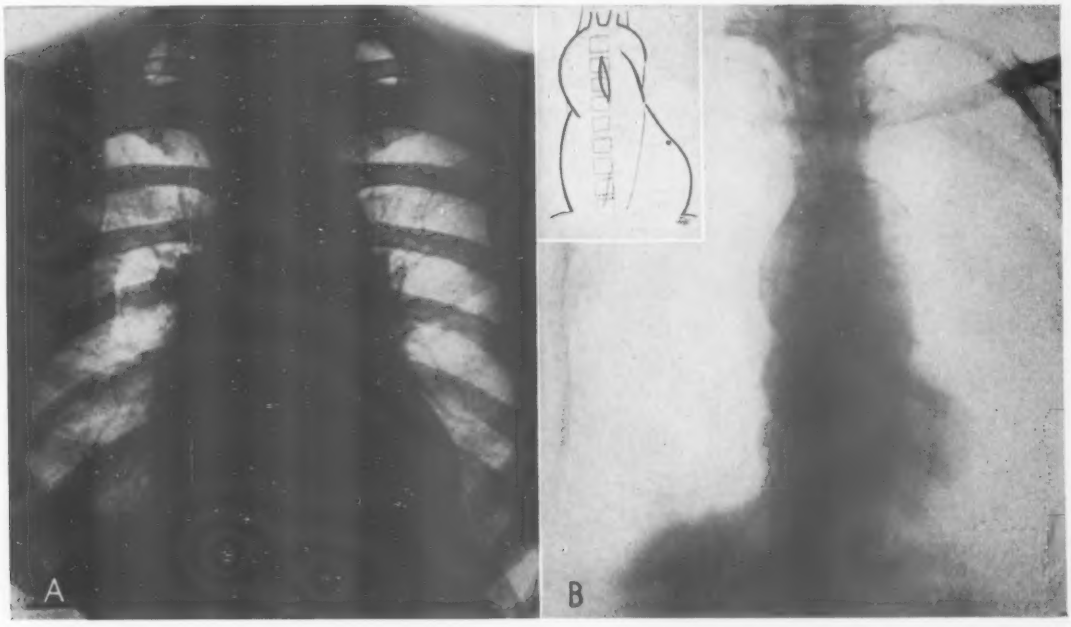


Fig. 1. *A*, routine teleroentgenogram. *B*, overpenetrated teleroentgenogram, showing aortic calcification, pulmonary artery, retrocardiac aorta, and hiatus between the two great vessels (see inset).

auricular enlargement with posterior displacement of the esophagus only. The importance of determining the position of the esophagus in more than one projection is apparent, and its visualization on the teleroentgenogram routinely is important in cardiac roentgenology.

The following cases illustrate the above points.

## CASE REPORTS

Case 1. D. M., female, aged sixty-five, housewife, was admitted with a diagnosis of hypertension.

A routine teleroentgenogram (Fig. 1*A*) shows calcification of the right border of the ascending aorta and the aortic knob. The cardiac contour is not distorted appreciably. Roentgenograms of the abdomen revealed extensive calcification of the aorta and splenic artery.

An overpenetrated teleroentgenogram (Fig. 1*B*) shows calcification in both the lateral and mesial borders of the ascending aorta, the origins of the innominate and left carotid arteries, and the lateral border of the proximal thoracic aorta. Immediately above the right atrioaortic angle supravalvular dilatation of the aorta is present. The descending thoracic aorta is not calcified, but its shadow can be seen through the cardiac density down to the diaphragm.

The main trunk of the pulmonary artery is visible, its outer border forming the second left cardiac arc. Between the internal margins of the pulmonary artery and aorta a small oval space resembling that noted post mortem is present.[3] This probably represents a hiatus between the great vessels.

The left anterior oblique view displays the arch of the aorta and the sites of the cephalobrachial vessels to advantage, while the right anterior oblique projection shows the foreshortened transverse aorta as a circular calcified shadow.

Case 11. K. V., male, aged sixty-six, printer, has shown symptoms of heart failure for about a year. He was told that he had high blood pressure several years before admission. The blood Wassermann is positive.

He was dyspneic, cyanotic and orthopneic on admission. There were signs of fluid in the left chest, and congestion in the base of the right lung. Pitting edema was noted over the flanks, scrotum and lower extremities.

Three days after admission 1,500 cc. of straw-colored fluid was withdrawn from the left pleural cavity. The patient improved under

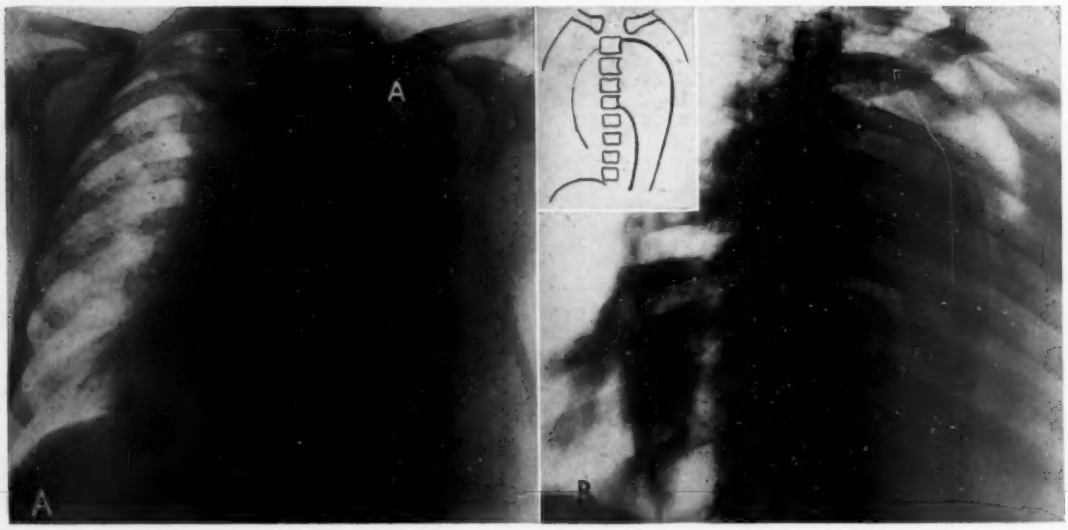


FIG. 2. *A*, routine teleroentgenogram. Thin translucent border over upper lung field (A). *B*, overpenetrated roentgenogram in dorsal position showing extensive calcification of aortic aneurysm (see inset).

a regimen of bed rest and diuretics, and was discharged symptomatically improved.

A routine teleroentgenogram (Fig. 2*A*) reveals almost complete opacity of the left hemithorax except for a thin translucent border along the upper periphery. The right lung field is encroached upon by the heart shadow.

An overpenetrated study in the dorsal position (Fig. 2*B*) reveals tremendous dilatation of the aorta down to the level of the tenth dorsal vertebra, where it resumes its normal caliber. The vascular walls are calcified from the origin of the aorta to the diaphragm, so that the diameter can be measured at any point within the

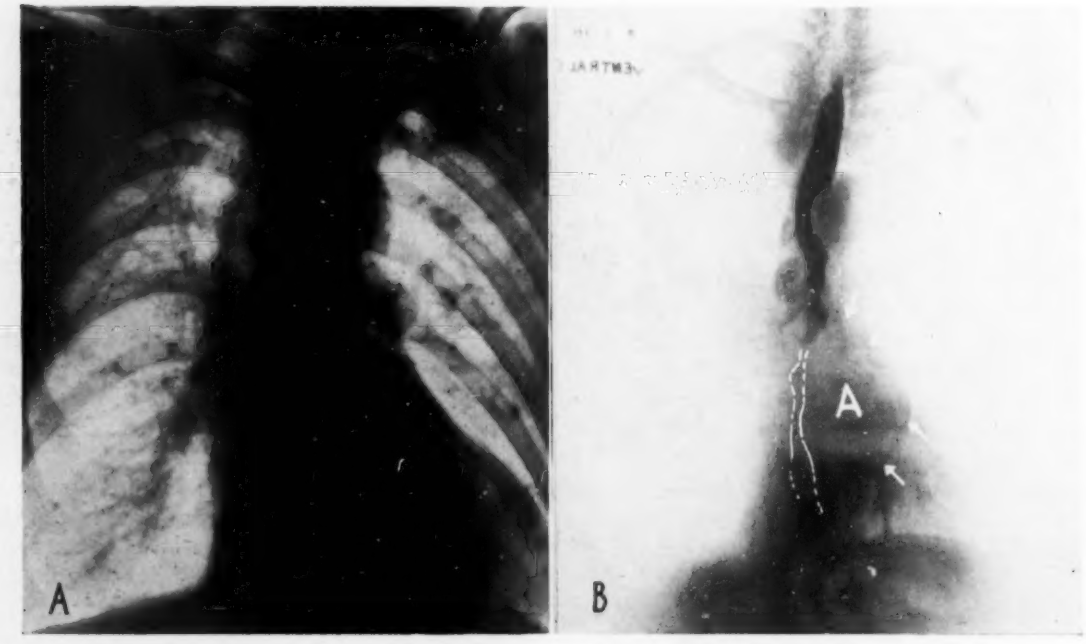


FIG. 3. *A*, routine teleroentgenogram. *B*, overpenetrated teleroentgenogram showing ovoid bulge in retrocardiac portion of descending thoracic aorta (A)

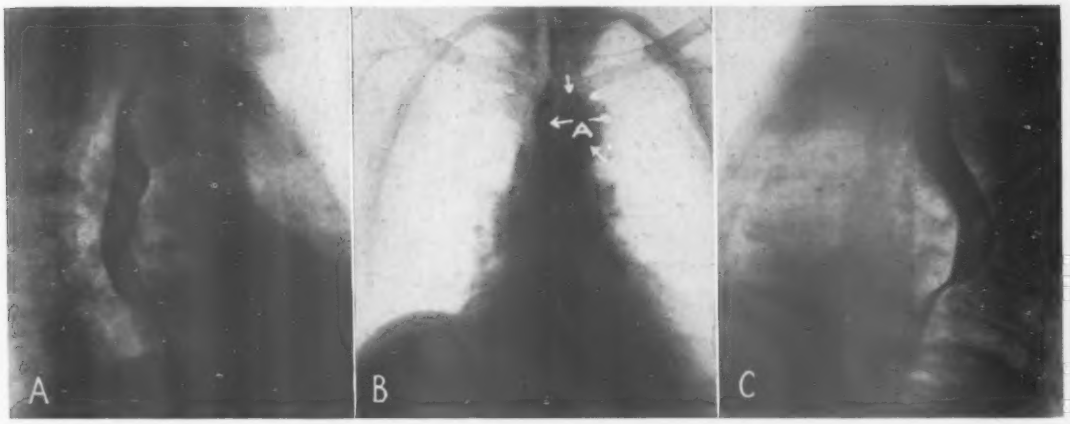


Fig. 4. *A*, right anterior oblique view of barium-filled esophagus showing its posterior convexity. *B*, overpentrated teleroentgenogram showing deviation of barium esophagus to the left and "aortic bed" (A). *C*, left anterior oblique view of barium-filled esophagus showing posterior displacement paralleling the aorta.

chest. The barium-filled esophagus shows a greatly increased aortic bed. Erosion of the left border of the upper dorsal vertebrae is present.

Case III. J. S., male, aged sixty-four, tailor, had been in chronic congestive heart failure for about five months. He was acutely ill when admitted. Dullness and crepitant râles were audible over both bases. About ten days after admission he complained of pain in the inguinal regions after being out of bed a short time. The pain persisted for about two days and subsided spontaneously, only to recur with increased severity soon thereafter. Within a few hours, he was in circulatory collapse, and soon died. The clinical impression was that the cause of death was a coronary occlusion.

A routine teleroentgenogram (Fig. 3*A*) shows an increase in the left transverse cardiac diameter.

An overpenetrated teleroentgenogram (Fig. 3*B*) reveals an ovoid bulge of the left border of the descending thoracic aorta at the level of the lower five dorsal vertebrae. The barium-filled esophagus is deviated slightly towards the right. Anterior displacement of the lower portion of the esophagus could be seen on films taken in the oblique positions.

At necropsy, aneurysmal dilatation of the lower portion of the thoracic aorta was found. The cause of death was a ruptured abdominal aortic aneurysm.

Case IV. R. S., female, aged fifty-seven, housewife, has suffered from hypertension for about five years.

A routine teleroentgenogram shows an increase in the left transverse cardiac diameter and a prominent aortic arch.

An overpenetrated teleroentgenogram (Fig. 4*B*) shows a good "aortic bed" and deviation of the esophagus to the left. In the right oblique view (Fig. 4*A*) the curve of the esophagus strongly suggests the presence of an enlarged left auricle. In the left oblique view (Fig. 4*C*), however, the posterior displacement of the esophagus is apparent.

The possibility of an erroneous diagnosis of left auricular enlargement was thus avoided.

Fig. 5. Overpenetrated teleroentgenogram showing normal position of barium-filled esophagus and prominence of the second left cardiac arc.

Case v. T. S., aged fifteen, schoolgirl, has been under treatment for rheumatic valvular heart disease for several years. There was no history of rheumatic fever or cardiac embarrassment. On physical examination a loud systolic murmur is audible over the entire precordium.

A routine teleroentgenogram reveals marked prominence of the second left cardiac arc.

On the overpenetrated teleroentgenogram (Fig. 5) the barium-filled esophagus is not displaced. If the abnormal frontal silhouette of the heart were due to valvular disease, displacement of the esophagus to the right by an enlarged left auricle should be present. Inasmuch as the position of the esophagus is normal in the oblique as well as in the posteroanterior view, a diagnosis of congenital heart disease is to be considered.

## COMMENT

The technique of overpenetration has also been useful in outlining the cardiac shadow in patients with opacities in the adjacent lung fields. Extension of the heart shadow below the diaphragm may be demonstrated. Shadows of double density on the right cardiac border in instances where the left auricle approaches the right border are sometimes seen. The contour of the thoracic spine can be determined, and instances in which a thoracic deformity was of differential diagnostic import have been noted. It is also possible to visualize the trachea and main bronchi.

## CONCLUSIONS

1. Additional information concerning the heart and aorta may be derived from overpenetrated teleroentgenograms. Visualization of the esophagus with barium paste is desirable.

2. In some instances it may be helpful to use the anteroposterior rather than the posteroanterior position to study the thoracic aorta.

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Vol. 40, No. 3

# CONCERNING ROENTGENOGRAPHIC DETAILS*

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ROENTGEN rays, after passing through the human body, reach the photographic film. This in turn, after development and illumination, causes certain impressions on our retina. Many-fold are the problems the roentgenologist has to solve to express in terms of human pathology all of the physicochemical changes that occur in these processes. The existence of such impressions is possible for one fundamental reason, i.e., our organs or tissues absorb the roentgen rays in different amounts, and the amount of difference in absorption is registered on the photographic film. The progress of diagnostic roentgenology during its forty-two years of existence consists of improving those impressions on our retina as to quantity and quality, and furthermore, of expressing them in more and more correct pathological terms.

Only the quantity of these roentgenographic impressions on our retina shall concern us in this paper.

Looking over some of the first roentgenograms taken in the nineteenth century, we are impressed by the quality of many of them, not only those taken of small animals or of plants, but also those taken of the human body. Roentgenograms of hands and feet and also those of chests sometimes compare favorably with the average roentgenograms of today. In other words, in the first years of medical roentgenology there were already present all the elements necessary to produce what we consider today a satisfactory roentgenogram; but although they were present, they were to a large extent unknown or known incorrectly and therefore they could not have been used systematically. Indeed one has to admire what was accomplished by the pioneers of medical roentgenology at a time when even the physical nature of the roentgen rays was unknown or understood incorrectly, and technical crudeness was a source of constant damage to the body as well as to the mind ("hyperconclusions"). Even recent publications prove that by simulating antiquated roentgenographic methods, useful roentgenograms can be systematically produced.

Now that the physical nature of roentgen rays has been proved, the time has arrived to analyze the many factors involved in roentgenography. The beginning of this work is not further than two decades back, and the results of it have to some extent found their way into our laboratories. Today we expect roentgenograms to show all the differences in absorption of roentgen rays, either in nature under healthy or pathological conditions, or artifically, when using contrast material.

The question, whether or not all the absorption differences are registered on our films, naturally cannot be judged solely by examining our roentgenograms. Direct physical measurements on dead organs and tissues have revealed that differences of absorption of from 5 to 12 per cent exist, where we do not see them expressed in our roentgenograms; even the difference amounting to almost 100 per cent between fat tissue and musculature is not always registered roentgenographically, although recently it has been shown that it should be noticeable through the whole range of roentgenographic work. Electroscopic measurements on the living human body gave equal results. Mathematical calculations of the absorption coefficient of different organs and tissues give basically similar results, although the values so received do not exactly coincide with the values of electroscopic measurement. For instance, if the specific absorption of muscle is 1,000 as measured with the electroscope, this value for liver is 1,075, and for spleen it is 1,118, while mathematical calculations based on the known chemical composition of these organs give as absorption coefficients $2.60\lambda^3$, $2.61\lambda^3$, and

* Read at the Fifth International Congress of Radiology, Chicago, Ill., Sept. 13–17, 1937.

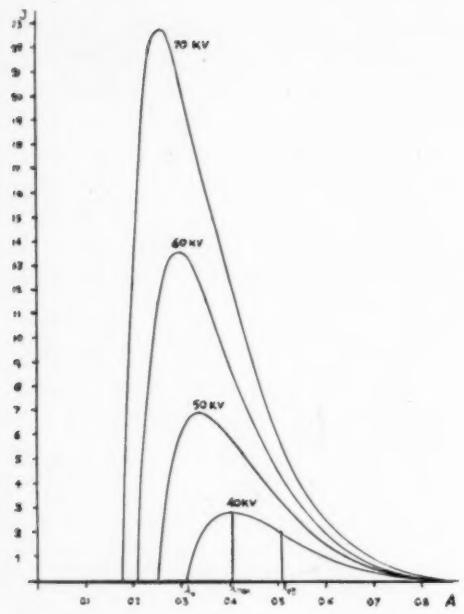


FIG. 1. Energy distribution according to wave lengths after the beam of rays has penetrated the wall of tube, using 40, 50, 60, and 70 kv. (peak) respectively, on the tube (after Zuppinger).

$2.61\lambda^3$, respectively. These calculations show no evident differences, although the results of electroscopic measurements are quite impressive to the contrary. But there are some further discrepancies. The calculated absorption coefficient for water is $2.50\lambda^3$, for tendon, $2.37\lambda^3$, for bile in the bladder $3.60\lambda^3$, for dry wood $1.74\lambda^3$, for ordinary glass from $13.98\lambda^3$ to $19.08\lambda^3$, for bone corticalis $13.24\lambda^3$, and for cartilage $2.70\lambda^3$. Contrary to this our roentgenograms do not differentiate between muscle and tendon, and not even between liver and gallbladder, or between muscle and dry wood. Ordinary glass, having a density higher than that of compact bone, is usually invisible, whereas cartilage is not rarely visualized in children's joints, although its density almost equals that of the muscle. Osteomyelitic bone destruction measuring 1 cm. in diameter may become invisible in the femur, and tumor metastases of both osteoplastic and osteoclastic type in the vertebrae are not seldom missed, using films of the customary gradation and the usual degree of darkness.

These facts are so surprising that an investigation is at least desirable. They prove that some phase in roentgenography is not done in a desired manner, and that we somehow actually spoil our chances for getting finer roentgenographic differentiation in spite of Nature's readiness to cooperate.

Looking up the three main factors in roentgenography: (1) the beam of roentgen rays, (2) the human body and (3) the photosensitive layer, we have to realize that the absorbing ability of our body is fixed, and no change can occur in this regard (not speaking here about contrast material). Regarding the roentgen rays, we know that their absorbability increases approximately with the third power of their wave lengths ($\lambda^3$). As to the film we know that it, like anything else, absorbs the roentgen rays approximately according to the fourth power of the atomic numbers ($Z^4$) of the composing elements. Therefore, the most logical procedure would be to use waves of the length of about 1 Å produced by 12 kv. (peak) on the tube. But we know that such wave length is almost totally absorbed by the wall of the tube and even a wave length of 0.5 Å after penetrating a 10 cm. thick layer of water retains only

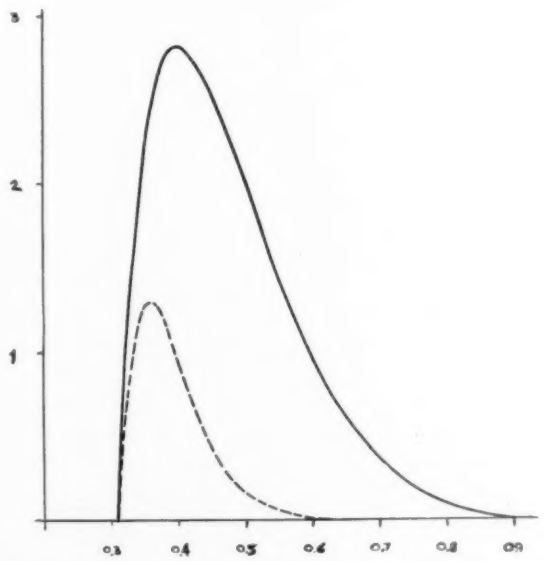


FIG. 2. Energy distribution according to wave lengths of a beam produced at 40 kv. (peak), before and after penetrating 10 cm. thick water layer, latter values ten times magnified (after Zuppinger).

0.007 of its original intensity. For this reason the longest wave that is still able to reach the film after penetrating the body cannot be selected to satisfy solely the $\lambda^3$ law. Figure 1 shows the distribution of intensity according to wave lengths as calculated by Zuppinger on the basis of Kulenkampff's formula, within the continuous spectrums used in roentgenography after the rays have penetrated the tube wall (1.7 mm. Al). We see, that even using 40 kv. (peak), the useful spectrum contains the waves of 0.4 Å in maximum intensity ($\lambda$ max.) which, however, after penetrating 10 cm. water suffer a reduction of their intensity to about 1/30; and as is more common, using 60 or 70 kv. (peak) $\lambda$ max. is in the region of 0.2–0.25 Å. Figure 2 shows the change of the useful spectrum at 40 kv. (peak) after having penetrated a water layer of 10 cm. thickness and so becoming the rest spectrum that actually reaches the film (intensities in rest spectrum are multiplied by 10 in the curve); it shows that $\lambda$ max. is of about 0.35 Å, and this wave length is reduced to 0.058 of its intensity during the change from useful radiation to rest radiation. Choosing thinner layers for penetration, this same wave length of 0.35 Å still retains 50 per cent of its intensity after penetrating a water layer of 2.5 cm. thickness (according to Siegbahn). Knowing that it requires about 1 r to produce on the film the ground darkness of grade 2, which is the most desirable from the physiological point of view using the customary sources of illumination, it is evident that wave lengths of 0.5 or more Å can be useful only in roentgenography of the thinnest parts of the human body, and even then only in soft tissue roentgenography, if we do not want to endanger or overstep the tolerance of the skin.

The human body and the beam of roentgen rays in the rest spectrum being fairly well determined, one possible way to increase roentgenographic details seems to be by utilization of the selective absorption of the photosensitive layer. Glocker has shown that the darkness of bromsilver film depends upon the roentgen-ray energy absorbed, and that it is independent of the wave length. He has further proved that in the region of the wave length 0.484 Å, which is absorbed selectively by the Ag atom, the darkness of film is also proportional to the absorbed roentgen energy. This wave length is absorbed by the Ag atom in about six times greater amount than the neighboring wave lengths, which

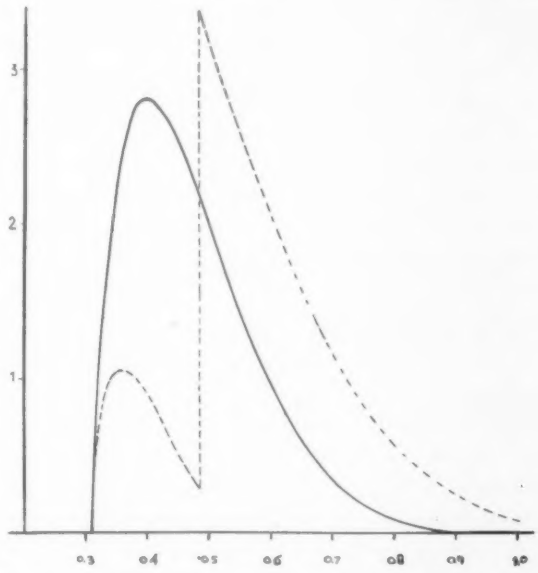


Fig. 3. Selective absorption of wave length 0. 48 Å by 0.04 mm. silver filter (after Zuppinger).

means that resulting darknesses on the film will show many times increased differences (Fig. 3). Assuming with Bronkhorst that a contrast of 0.075 is the least contrast we are able to distinguish clearly, and knowing that contrast is a function of the gradation, i.e., the $\gamma$ value of the film and of the difference of the logarithms of the roentgen energies reaching the film, the recognizable lowest limit of contrast will be achieved even when the difference in roentgen-ray absorption of the contrasting media is considerably diminished. In other words, absorption differences producing a contrast below the limit of sensation (0.075) and therefore lost in medical roentgenology can still be recognized by using roentgen rays that are selectively absorbed by the photosensitive material. Today, the bromsilver film being used exclusively in roentgenography, we cannot proceed in re-

covering lost contrast, because the wave length of 0.484 Å which is selectively absorbed by the silver, as explained before, suffers such a great loss of intensity when penetrating the human body that in the rest spectrum it is not present in quantity sufficient to produce a roentgenogram (not speaking about the wave length 0.918 Å, which would be selectively absorbed by the Br but which is completely filtered out by the wall of the diagnostic tube). The λ max. in the rest spectrum must be considerably shorter, probably between 0.2 and 0.3 Å, but the photosensitive layer must absorb selectively this wave length. This means, that there should be found an element much heavier than silver, having photosensitive properties, that would make the ideal film material for human roentgenography.

Working with roentgen rays that are selectively absorbed by the photosensitive layer presupposes that the diagnostic beam be monochromatic. If the $\lambda^3$ law of absorption is fully utilized, such monochromatic radiation is to be selected for each thickness to be roentgenographed, and wave lengths are still further to be determined to correspond to the absorption coefficients of the different objects in question. The photosensitive layer has to absorb the monochromatic radiation selectively in each instance and therefore its gradation can be extremely steep.

The output of radiation can be intensified many times over the present output by using anode material suitable for characteristic emission of the wave length desired in the case. This feature can be utilized for further shortening of the exposure time, and it may lead to the complete elimination of intensifying screens, with all of their disadvantages, without which present-day roentgenography cannot exist. Increasing the focus-object distance may take such dimensions that parallel projections, instead of the central one, in roentgenography may come within the realm of probability. The increase of focus-object distance has its definite influence also upon the scattered radiation, inasmuch as by considerably reducing its amount the contrast is increased very markedly. The harmful portion of scattered radiation, that is the result of the Compton effect, is reduced by eliminating the waves shorter than the edge of the absorption band from the useful spectrum.

SUMMARY

Considering the interrelation between beam of roentgen rays, the human body and photosensitive layer, upon the basis of known facts, it seems that further differentiation in human roentgenography is obtainable by (1) working with monochromatic radiation that consists of the characteristic emission of a suitable anode material; (2) choosing in this monochromatic radiation the longest wave length possible which is fit to solve the roentgenographic problem in question; (3) using photosensitive material which selectively absorbs the rest spectrum; (4) increasing the focus-object distance to reduce the amount of scattered radiation, and (5) elimination of intensifying screens.

The first steps have been made to carry out experiments to prove or disprove these conclusions.

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Vol. 40, No. 3

# THE EVOLUTION OF CHEST ROENTGENOGRAPHIC TECHNIQUE

## WITH SPECIAL REFERENCE TO THE MODERN CONCEPT

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DURING the development of any particular branch of medical science there are, of necessity, periods of experimentation in which various angles of the problems encountered are explored. Eventually the time is reached when it becomes advisable to compile all the essential data that have accumulated and to integrate the essential facts into a satisfactory and workable scheme. There is, perhaps, nothing of greater importance in the field of chest roentgenography, at the present time, than an acceptance of a standardized technique which will make available, for the profession at large, comparable chest films.

Forty years ago the exposures were long and the target-film distances were necessarily short, and therefore poor contrast in the film was unavoidable. Ten years later, Lewis Gregory Cole blazed the way with a much finer grade of roentgenogram, by his patient and wise use of the gas tube. His contemporary, Kennon Dunham, demonstrated the value of a good film by exhibiting his well-remembered Dunham fan. Both these pioneers appreciated the desirability of good definition and of proper density in roentgen films.

The development of the Coolidge tube with its hot cathode and pure electron discharge marked a very substantial step towards the standardization of technique. It has enabled a reduplication of results with regularity. Then came a period when our efforts were directed towards speed and the arrest of motion. Intensifying screens came into play, materially increasing contrast by allowing less penetration to be used. More powerful machines were introduced. A fine focus tube that could stand greater energy was conceived, tending to increase target-film distance and to shorten time of exposure. Bridge,[1] in his excellent work, demonstrated the usefulness of this high power equipment. Subsequently a rotating anode tube with a fine focal spot of high current carrying capacity has been marketed.

Happily, our physicists have kept pace with all these rapid developments and have pointed out, not only the desirable characteristics which must be encouraged, but those disadvantages which must be overcome.

Ten years ago chest roentgenograms were made at 3 feet with relatively large focal spots, and yet correct diagnoses were possible in the vast majority of instances. One might say we understood the language of those shadows. Truly, the quality of the chest roentgenograms possible today is far superior to that formerly obtained, and those in the roentgen field who have worked during this period of time have gradually become aware of the transition. Diagnosis, or preferably the interpretation of the pathological process present, is based upon much more than the detail of the shadows. However, it cannot be denied that every step taken toward a finer definition of the shadows is worth while.

The present day concept of a good chest roentgenogram should represent the result obtained after the proper manipulation of voltage, milliamperage, time, focal distances and focal spot. The individual char-

*A* *B*

FIG. 1. *A*, chest model (wax); *B*, penetrometer (wood).

acteristic, the cause and the effect of each of these factors must be understood.

Our experience has been of a practical nature and whatever conclusions drawn are based upon the study of stereoroentgenograms. In our studies we have paid particular attention to the following points: (1) time of exposure; (2) penetration (contrast); (3) target-film distance; (4) definition of shadows.

(1) *Time of Exposure.* The factors considered and studied are those of the effect of motion of the part and of the tissues of such parts to be roentgenographed. Measurements of the unsharpness produced by moving pieces of lead were made by means of an apparatus designed to carry these objects at a given speed. The result of the test has proved conclusively that rapidly moving objects require high speed while with motions of about 5 mm. per second (accepted average speed of motion for pulmonary tissues) a satisfactory roentgenogram is made in from 1/10 to 1/20 second exposure.

(2) *Penetration* (*Contrast*). At present, we know of no photometric way of evaluating lights and shadows in terms of pathology. We can take a step table (a penetrometer) and demonstrate conclusively that low kilovoltage technique will differentiate more brilliantly between the successive steps than will a higher kilovoltage, but we also know that it will not retain both ends of the penetrometer, if the latter has sufficient steps.

Hence, the problem confronting us is the consideration of the chest as such an instrument of measurement. If we realize the variation in density from the normal aerated lung to, and including an area of disease, say of consolidation, we should be convinced that we are dealing not only with a long range penetrometer but one of very delicate variations. Consequently, we can strive only to obtain the greatest number of steps of densities as are found to be most useful for diagnosis in the greatest number of cases, sacrificing perhaps, visibility at the extreme ends of the penetrometer. These desirable characteristics, we believe, are to be used for the more specialized studies of tissue differentiation.

In the film, penetration is revealed by the relative value of the blacks and the whites and half tones. From these tones one attempts to deduce many things. It is upon the relative value of the shadow that one determines the activity of the process. The merging of the shadow with the surrounding normal tissue may be gradual or abrupt, and students of the film feel reasonably secure in drawing conclusions one way or the other. Also, the differentiating of caseous and exudative lesions from the proliferative and fibrous is a matter of shadow contrast evaluation.

It is conceivable to believe that with improper technique producing greater con-

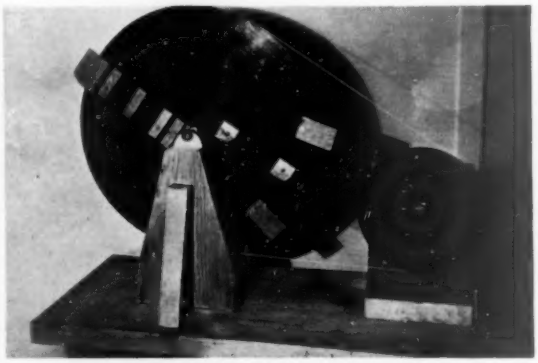

FIG. 2. Device (Lasher) for measuring geometric and movement unsharpness.

trast one might be misled in his deductions. It is a common occurrence to have a film which exhibits too much contrast suggesting a reactivation of a focus, whereas a film of the proper shadow values would not convey this impression.

With this in mind, the use of the grid technique naturally suggests itself. Within the past few years a great deal of attention has been paid to the use of one or another form of grid for chest roentgenography. This is a natural trend because of the fact that roentgenograms produced in this manner are more brilliant in shadow differentiation. The principle of the grid is based on the elimination of objectionable extraneous radiation which otherwise has a fogging effect upon the film. The one advantage of a grid is that under certain conditions the differentiation of tissue density is more clearly demonstrated than by other methods. A series of experiments with step

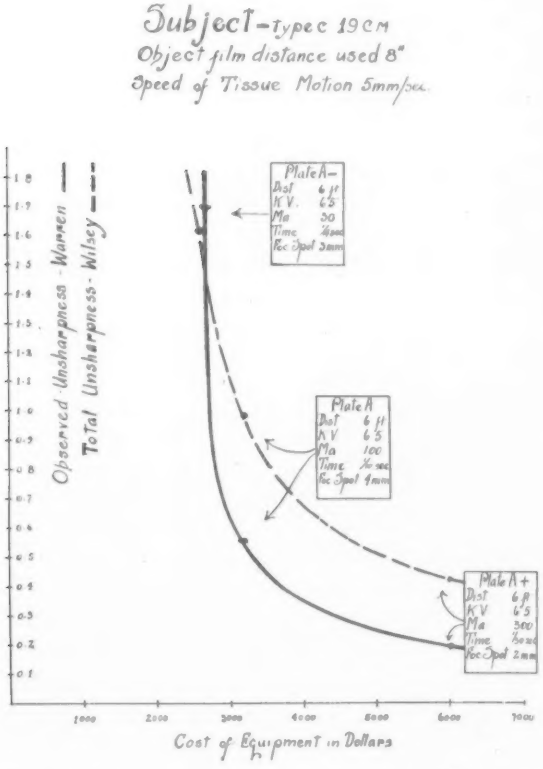


Fig. 3. Curves showing type of roentgenograms based on calculated unsharpness in relation to cost of equipment.

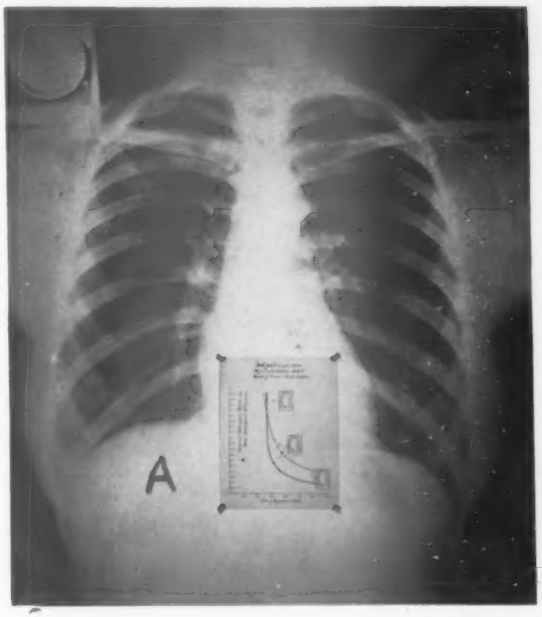


Fig. 4. Roentgenogram *A*, showing satisfactory contrast and definition of excellent diagnostic qualities. Technique: 100 ma., unsharpness 0.5 mm., approximate cost $3,200.00.

tablets or penetrometers reveal that one is able to differentiate the individual variations over a greater range in a 49, 1 mm. step aluminum penetrometer than by any other procedure. Consequently, on the basis of differentiation of tissue densities only, it would seem as though the grid has an advantage. Nevertheless, there are equally important factors which render the grid unsatisfactory. For example, stereoroentgenograms cannot be made with facility and the occurrence of objectionable grid marks is apt to mar the daily output.

(3) *Target-Film Distance.* A series of roentgenograms of the chest and of lead strips (mechanical test) were made. When studied by different roentgenologists, as well as ourselves, we were convinced that the increase of motion unsharpness, as produced by increased time, is apparently compensated for by the decrease of the geometric unsharpness brought about by the small focal spot at 6 or 7 feet. This is corroborated by Warren's[2] formula of observed unsharpness.

It is now proved that with increasing

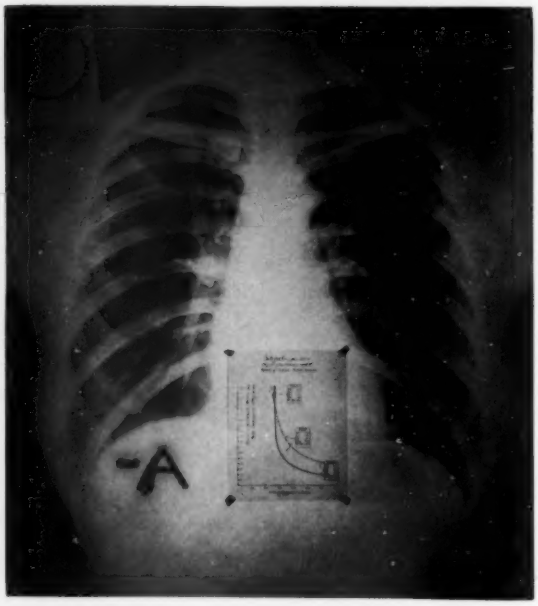


FIG. 5. Roentgenogram $-A$, showing satisfactory contrast but poor definition. Satisfactory for diagnosis with limitations. Technique: 30 ma., unsharpness 1.7 mm., approximate cost $2,700.00.

target-film distances, the undesirable enlargement becomes progressively diminished. Wilsey[3] states, "Most of the decrease in enlargement has occurred within the 4 foot distance, beyond this the enlargement diminishes very slowly." On the other hand, as distance increases, the area of the focal spot also must increase in proportion to the square of the focal film distance which, *per se*, tends to nullify any gain in sharpness from long distances unless the efficiency of the focal spot (current carrying capacity) is increased by a greater anode slope or by anode rotation or both.

(4) *Definition.* To become personally acquainted with the significance of definition, it is an easy matter to roentgenograph an object, using tubes having different focal spots and various tube-object film distances. Such experiments reveal that there is a relatively wide latitude within which nearly any roentgen laboratory can operate.

Files[4] very concisely sums up this phase of the subject by stating that the best diagnostic results can be obtained only when a tube is used which has the smallest possible focal spot consistent with the part to be roentgenographed.

Hence, we can confidently fall back on small focus tubes (preferably rotary targets), moderate kilovoltages, 5 to 7 foot distance, and 1/10 to 1/30 of a second exposure for the finest of stereoroentgenograms.

With the above factors in mind, it is quite natural to ask the question, "What is the relative cost of this equipment?" At the present time there are three commonly used methods of producing roentgenograms. These might be designated as 30 ma., 100 ma. and 300 ma. technique. The first permits of exposure in the neighborhood of $\frac{1}{4}$ second, the second 1/10 second and the last, depending upon the size of the machine, as fast as one impulse of 1/120 second. The focal spot of the tube in the first two can be as small as 3 or 4 mm., respectively; the last, 300 ma. technique, permits the use of a rotating target with a 2 mm., or less, focal spot.

The relative gain in definition (sharpness of shadows) in relation to cost of apparatus is shown in the accompanying graph. For

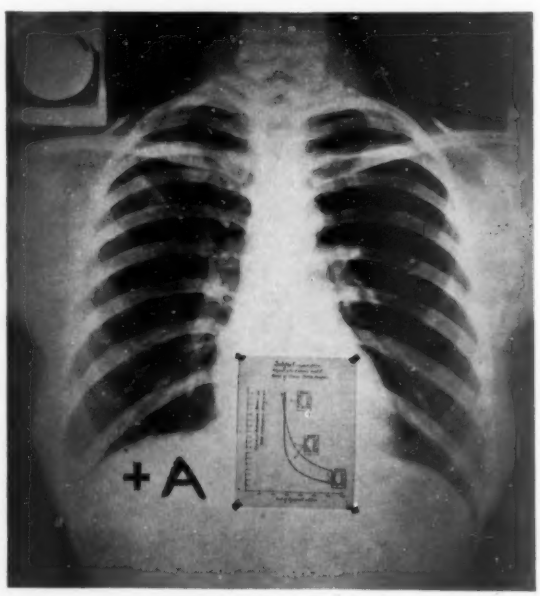


FIG. 6. Roentgenogram $+A$, showing satisfactory contrast, excellent definition and diagnostic qualities. Technique: 300+ ma., unsharpness 0.2 mm., cost $6,000.00.

an expenditure of a little less than $2,700.00 the 30 ma. technique can be used. With an additional expenditure, bringing the cost of equipment somewhere in the neighborhood of $3,200.00, a material gain in the quality of the roentgenogram is obtained. From this point to the rotary target technique, there is slight increment in quality of the film, so that the physician must decide whether this increased cost of $6,000.00 is commensurate with this improved detail. A good many feel this step is worthwhile but we must not overlook the point that a roentgenologist can produce excellent diagnostic roentgenograms by the use of 100 ma. technique.

In conclusion, we believe that a standardized diagnostic chest roentgenogram can be a fact and can efface Sir William Osler's[5] statement: "More than any others, radiographers need the salutary lessons of the dead house to correct their visionary interpretation of shadows." It is now possible for the roentgenologist to obtain a film which will enable him to make the diagnosis of early pulmonary tuberculosis and to follow the progress of his case intelligently during life.

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# HYDROPNEUMOPERICARDIUM*

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HYDROPNEUMOPERICARDIUMis, as all physicians are aware, a rarity in medicine, so rare that it might almost be called a medical curiosity. Physicians engaged in active practice for many years may never encounter a single case. A brief search through textbooks and medical literature reveals 81 cases reported during a period of approximately one hundred years, 38 of which were reported prior to the advent of the roentgen ray.

To the list of reported cases of hydropneumopericardium is added the one described below, which is the eighty-second case and the eleventh one resulting from paracentesis.

## REPORT OF A NEW CASE

J. O. G., white male, aged thirty-two, a native American, bottler by occupation. His father, aged fifty-five, and his mother, aged fifty, were both living and well. Four sisters living and well. No history of tuberculosis, lues or insanity in the family. Had measles and whooping cough at the age of eight. No injuries or operations. Venereal disease denied.

Patient entered the hospital complaining of cough, loss of weight and general weakness. The loss of weight had been progressive for several months. There was difficulty in breathing and shortness of breath on climbing stairs and on slight exertion. Patient stated it was necessary, at times, to sleep in the erect position.

Physical examination showed a white male who appeared chronically ill, poorly nourished and developed; complexion sallow; height 67 inches; weight 128 pounds (normal weight 135 pounds). Eye, ear, nose and throat examinations negative. Systolic blood pressure 112, diastolic blood pressure 72. Pulse 120; temperature 100°F. Abdomen negative for masses, scars and tender areas. Liver, kidneys and spleen negative. Rectum negative for fissures and hemorrhoids. The genital organs, thyroid and glandular systems, scalp, skin, reflexes, bones and joints disclosed negative findings. Muscles were of fair tone. There was slight edema of both ankles.

Chest examination showed slight retraction of the supraclavicular areas. On percussion, slight dullness was elicited over both apices. Auscultation revealed soft, crepitant râles and increased voice sounds over both upper lobes. Heart sounds were weak and distant; unable to get apex beat. Dullness was increased beyond the point of maximum intensity of the heart sounds.

Laboratory report disclosed the blood Wassermann and Kahn reactions to be negative. Sputum was positive for tubercle bacilli, Gaffky IV.

Patient was referred to the roentgen department for examination of the chest, with a provisional diagnosis of pulmonary tuberculosis. The stereoscopic roentgenograms, taken at 2-meter distance, displayed the following information: Contour of the domes of the diaphragm was smooth, showing no evidence of adhesions. Costophrenic angles appeared deep, acute and clear, exhibiting no abnormal shadows to suggest fluid, adhesions or thickened pleurae. The bony framework of the thoracic cage was barrel-shaped and symmetrical, disclosing no scoliosis, kyphosis, cervical or forked ribs. The anterior and posterior intercostal spaces were of normal and even width. Bifurcation of the trachea was opposite the body of the fourth dorsal vertebra.

The silhouette or cardiac image showed a central, water-bottle type heart, enlarged in all diameters: the greatest transverse diameter measured 24 cm., the greatest internal chest diameter 27 cm. and the aortic arch 5 cm. Borders of the heart were smooth and reached approximately to the chest wall, bilaterally. The configuration of the heart gave the roentgen impression of pericarditis with effusion (Fig. 1).

The lung fields exhibited a soft, flocculent, snow-storm effect, infiltrating all zones of the

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upper lobes and giving the roentgen impression of pulmonary tuberculosis of the caseous, bronchopneumonic type.

On account of the extreme dyspnea and the pericardial effusion reported on the roentgenograms, a paracentesis was performed and 2,200 cc. of fluid was withdrawn from the pericardial sac. A guinea pig inoculation with the pericardial fluid was positive for tubercle bacilli. A few days following the paracentesis, the patient had a violent coughing spell which resulted in a sudden, sharp pain in the back, and the shortness of breath became more noticeable. He claimed to have had a sensation as though something had given way within the chest. Breathing was somewhat labored and there was persistent cough with mucopurulent expectoration. No cyanosis was present.

Re-examination of the chest showed tactile fremitus to be diminished over both bases. The percussion note was impaired in both apices. Upon ausculation of the right lung, increased whispered voice sounds and subcrepitant râles were heard from the second anterior rib and fourth dorsal vertebra to the apex. The left lung disclosed increased voice sounds, rough bronchial sounds and râles from the third anterior rib and fifth dorsal vertebra to the apex. Many subcrepitant râles were heard at both bases. There was marked tympany over the cardiac region. On auscultation the breath sounds were harsh and prolonged. The expiration pitch was high. In prone position heart sounds were absent, but when the patient was placed in an upright position a slight metallic ring or a sound resembling the splashing of water could be heard over the precordial region.

Fig. 1. Large water-bottle type heart, indicative of pericarditis with effusion, the pericardial borders apparently reaching the lateral chest walls.

Fig. 2. Same case as Figure 1, taken at a later date and following paracentesis, showing thickened pericardium forming shadow-lines extending from the hila to the bases. The fluid within the pericardial sac does not present a horizontal fluid level, due to the agitation caused by the heart's action.

The chest specialists thought the above findings were caused by spontaneous pneumothorax with accumulation of fluid at the bases. However, the roentgenographic and roentgenoscopic examinations definitely determined the presence of a hydropneumopericardium.

Roentgenograms showed the pulmonary findings to be essentially the same as those displayed and reported on previous films, with the exception of heavier infiltration in the lung fields and the presence of two shadow-lines approximately 0.5 cm. in diameter and 20 cm. long, extending from the hila in the region of of the fifth dorsal vertebra, downward and outward to the bases, blending with and becoming lost in the abnormal density in these areas. These abnormal shadows adjacent to the heart image were distended, with slight bulging on the left side (Fig. 2). The cause of these shadows could not be determined from the roentgenogram alone. The heart silhouette was reduced considerably in size and shape since the previous examination. A homogeneous shadow of heavy density was seen in lower half of cardiac region within above described shadow-lines.

Patient was requested to return to the roentgen department for further study and examination of the chest, with special reference to the abnormal shadow-lines depicted in the lower mediastinum and to evaluate and determine the cause of these unusual markings.

The roentgenoscopic screen disclosed a hydropneumopericardium, presenting one of the most amazing sights that it has ever been the privilege of a few roentgenologists to witness. The roentgenoscopic examination, with the aid of an opaque meal, showed the contrast medium flowing freely through the esophagus and entering the stomach normally, thus eliminating the presence of a cardiospasm or thoracic stomach. The shadow-lines extending from the hilar regions to the bases proved to be thickened pericardium anchored and held a considerable distance from the heart, allowing free pulsation of this organ within the pericardial sac. The shadows of irregular outline seen on the film adjacent to the base of the heart proved to be fluid within the pericardial sac and surrounding the lower half of the heart. No fluid level could be demonstrated within the pericardial sac, due to the agitation produced by the heart's action. The heart itself could be plainly seen through the roentgenoscopic screen as it churned and agitated the pericardial effusion "ressemblant l'action de la roule hydraulique" (resembling the action of a water wheel). The tympanitic note was replaced by dullness, and vice versa, upon changing the position of the patient.

Patient died two weeks later and the diagnosis of pulmonary tuberculosis and hydropneumopericardium was confirmed at autopsy.

### CAUSATIVE FACTORS PRODUCING HYDROPNEUMOPERICARDIUM

| | |
|---|---|
| Abscess of liver | 1 |
| Attempted paracentesis or pneumothorax | 11 |
| Cancer of esophagus or stomach | 4 |
| Empyema | 2 |
| Erysipelas | 1 |
| Foreign body in esophagus | 4 |
| Gangrene of lung | 1 |
| Pericarditis | 8 |
| Septicemia | 4 |
| Suppurating arthritis | 1 |
| Trauma | 23 |
| Tuberculosis of glands or lungs | 11 |
| Ulcer of esophagus or stomach | 9 |
| Undetermined | 2 |
| Total | 82 |

It is interesting to note that a majority of these cases of hydropneumopericardium have resulted from some pathological process within the body. The next most frequent cause of this condition was by external agents. Another common cause was due to paracentesis which accidentally admitted air into the pericardium.

### SUMMARY OF CASES IN THE RECENT LITERATURE

Brailsford's[1] case was that of a man, aged forty, who had symptoms of pulmonary tuberculosis for five years. Aside from severe dyspnea of five months' duration, no other symptoms suggesting cardiac disease could be elicited and there were no physical signs of a hydropneumopericardium.

Roentgenoscopic and roentgenographic examinations were made because of marked dyspnea. They showed fluid and air in the pericardial sac, together with lung changes suggestive of chronic phthisis. Similar studies one month later displayed no change. Three months after the original examination, the roentgen studies were repeated and the whole appearance had changed. No fluid or air could be demonstrated in the pericardial sac and the heart shadow appeared to be normal. The patient said he had "vomited" a large quantity of foul-smelling matter since the previous examinations.

Parson's[3] case was a white male, aged forty-two, who had malaria as a boy; otherwise he had never been ill. May 29, 1931, while working in a small outhouse, he made a misstep causing him to fall an approximate distance of 3 feet, striking the left anterior chest wall against the sharp corner of a sturdy box. Immediately, he noted a pain in his left chest; his respiration became rapid and he felt faint. About thirty minutes later he was conscious of a striking and peculiar sound in the region of his heart. Twelve hours after the accident, members of his family could hear the sound across the room, a distance of about 8 feet.

Physical examination was negative except for the findings referable to the thorax. In the fifth intercostal space, in the midclavicular line, there was an area of subcutaneous emphysema, 2 cm. in diameter. Palpation of the sixth left rib, immediately below the area of emphysema, elicited tenderness. The percussion note was tympanitic over practically the entire left chest, except at the extreme base where it was flat. Auscultation and palpation elicited findings consistent with a diagnosis of a pneumothorax and a small hydrothorax on the left. When the patient was raised to the sitting position, there was no demonstrable shift in the tympany over the precordial area nor of the area of dullness to the right of the sternum. On stethoscopic examination, a loud metallic splashing sound was heard. The patient likened

it to the noise made by suddenly moving a hot water bottle partly filled with water. This sound was loudest directly over the heart. The roentgenographic examination of the chest revealed a fracture of the sixth left rib in the midclavicular line. No other roentgen findings were reported.

Shackelford[4] reports a case of a white man, aged sixty-one, occupation mechanic, hospitalized on January 24, 1930. Patient had been feeling in his usual good health up until Christmas night, 1929, one month before admission to the hospital. That evening he did not feel as well as usual, in exactly what way he was unable to describe, and retired early, falling to sleep shortly. Early in the morning he was suddenly awakened with a severe pain in the region of the shoulder blades. At the same time he was short of breath, being unable to lie down, as it increased the dyspnea. This dyspnea was expiratory in character, inspiration being accomplished with comparative ease. Two weeks after the onset, the patient was feeling quite well, got up to shave and while leaning forward in the act of shaving he heard a metallic clicking sound in his chest.

Physical examination on the day of admission revealed temperature 98°F. and pulse rate 85. Breathing was regular and easy. The thorax was markedly deformed, barrel shaped and asymmetrical, the right side bulging more than the left; it was rather rigid and moved little on respiration. Tactile fremitus was diminished over both lungs. The percussion note was impaired at the right apex posteriorly; elsewhere it was resonant, with marked tympany over the precordial region. With each systole, there was a loud, metallic ringing splash followed immediately by a shower of less intense splashes, the whole resembling the dipping of water from a deep well. The sound was similar to the noise made by an old fashioned churn.

A flat roentgenogram, as read by Dr. F. J. Baetjer, revealed fairly extensive fibroid tuberculosis of both upper lobes and slight dilatation of the aorta. The heart was normal in size. The stereoscopic left lateral films of the chest disclosed a normal heart.

Fig. 3. Roentgenogram showing the generally typical characteristics of a true hydropneumopericardium. (Reprinted through the courtesy of Dr. James T. Case, to whom I am indebted for the loan of the reproduction. This illustration was formerly published and reported by Stewart.[5])

## COMMENT

Brailsford published reprints of the roentgenograms purporting to be a hydropneumopericardium but, upon close examamination of these reproductions, a definite horizontal fluid level was depicted which is similar to the fluid shadow found in a thoracic stomach, cardiospasm or hydropneumothorax. His illustrations show the fluid shadow to be on only one side of the heart and the fluid forming acute angles at its junction with the proximal and distal retaining walls. I do not believe it is possible to obtain a horizontal fluid level with acute angles in a true case of hydropneumopericardium, as the ever-moving heart causes agitation of the fluid and produces a wavy shadow-line or irregular outline of the fluid. (This distinction between a fluid level and a fluid line must be borne in mind.) Even a film taken at a tenth, a twentieth or a sixtieth of a second would show some distortion of the fluid level.

It is my contention that in a hydropneumopericardium the essential distinguishing features displayed on the roentgenogram are:

(1) A fluid shadow on both sides of the heart.

(2) Fluid practically of equal distribution on both sides of the heart.

(3) Obtuse angles at the junction of the fluid with the distal wall of the pericardium.

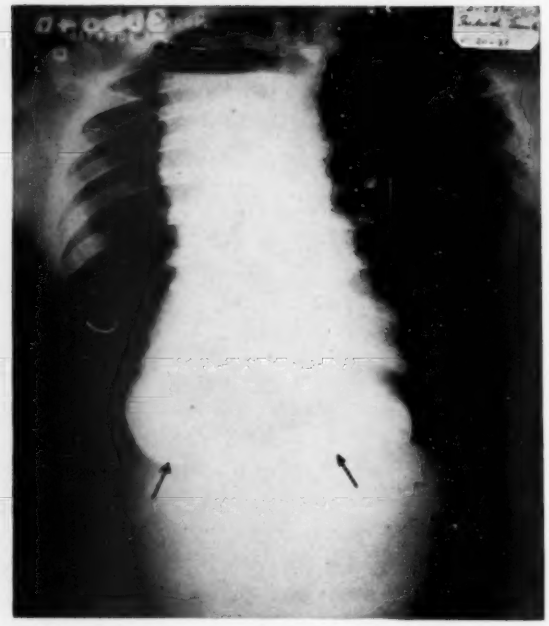

FIG. 4. Typical roentgen illustration of a cardiospasm, showing barium and fluid in the esophagus and presenting a horizontal line in the upper mediastinum.

(4) A definite fluid line (not a fluid level) of irregular or wavy contour.
(5) Bilateral displacement of the pericardium.

An excellent and instructive illustration of the above is shown in Figure 3. Under the roentgenoscopic screen, which is a valuable aid in making a differential diagnosis, the following characteristics are noted: (*a*) the heart can always be observed within the pericardial sac churning the fluid; (*b*) the pericardium is distended; (*c*) fluid can be seen on both sides of the heart shadow; (*d*) the fluid line is in constant agitation, alternately rising and falling on either side of the cardiac shadow as the heart changes its position and size during systole and diastole.

I have seen many cases of cardiospasm with an enormously dilated esophagus partially filled with fluid and air and showing a horizontal fluid level (Fig. 4) simulating the roentgen findings of a hydropneumopericardium. I have also had the opportunity of finding a case of a thoracic stomach in which the gastric secretion and fluid presented a horizontal level (Fig. 5), resembling the case reported by Brailsford as a hydropneumopericardium. In both of these types of cases the administration of opaque medium, in conjunction with the roentgenoscopic examination, was a valuable aid and one of the cardinal factors in making a differential diagnosis, ruling out a hydropneumopericardium and establishing the presence of either a cardiospasm or a thoracic stomach. In Brailsford's case, the fact that the patient vomited a large quantity of foul-smelling matter would further tend to suggest a cardiospasm or a thoracic stomach.

The roentgenoscopic examination, which is considered an important aid in making or confirming a diagnosis of hydropneumopericardium, was not employed by Parson, Shackelford, and others.

Parson based his diagnosis on the loud, metallic, splashing sound synchronous with the cardiac systole, which alone is not conclusive evidence of a hydropneumoperi-

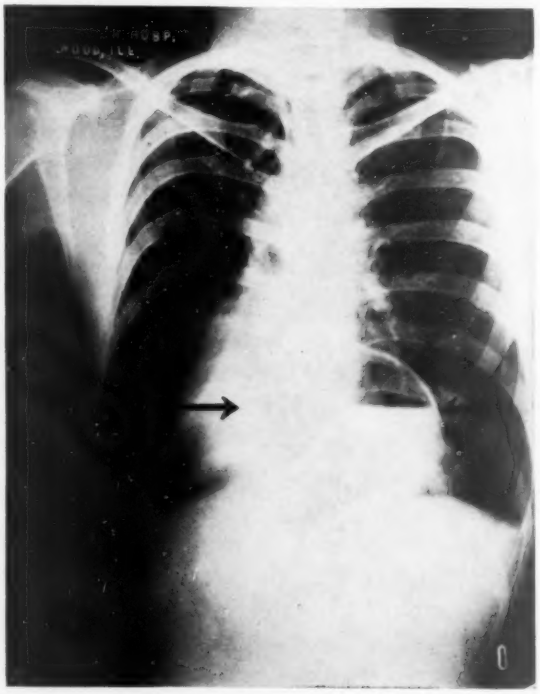

FIG. 5. Fluid in a thoracic stomach, showing a horizontal line crossing the right border of the heart. This line does not extend to the left cardiac border.

cardium, as these sounds are often heard in cases of hydropneumothorax.

Shackelford assumed that his case was a hydropneumopericardium caused by rupture of the pericardium with the entrance of air which was later absorbed, leaving no trace of this condition on the roentgenograms. However, Shackelford's diagnosis was made from the clinical history or physical findings and not roentgenographically, as Baetjer's interpretation of the films showed the heart to be of normal size and shape.

Only a limited number of reproduced roentgenograms have been published recording the findings of a hydropneumopericardium. However, except for the cases of Leys[2] and of Case (Fig. 3), I cannot concur in many of the published illustrations and case reports, including the three discussed above, as depicting the typical findings of a hydropneumopericardium. In addition to my own reported case, it is believed the reproduced roentgenograms of Leys and Case represent the only authentic illustrated cases of a true hydropneumopericardium.

## CONCLUSIONS

Many case reports have been published of hydropneumopericardium, only a very limited number of which were accompanied by reproductions of the roentgenograms. In reviewing the literature I found that most of the illustrating roentgenograms did not present the characteristic findings of a hydropneumopericardium; these and many of the cases that were not illustrated were, in my opinion, erroneously diagnosed as such. I do not believe a definite diagnosis of this condition can be made from the clinical symptoms or physical findings without the aid of the roentgenoscopic and roentgenographic examinations.

Many of the reported cases might have been either a hydropneumothorax, thoracic stomach, dilated esophagus or mediastinal effusion, as it is my opinion that not only are the roentgenographic and roentgenoscopic examinations a valuable and necessary aid in establishing a diagnosis of hydropneumopericardium, but that the administration of contrast medium, in conjunction with the roentgenoscopic examination, is essential in making a differential diagnosis and in excluding the possibility of dealing with a cardiospasm, thoracic stomach or other pathological conditions presenting similar findings.

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# END-RESULTS OF IRRADIATION OF THE THYMUS GLAND IN TWENTY-SEVEN NORMAL INFANTS AND CHILDREN

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WE APPRECIATE that a study of 27 cases does not comprise a large group upon which to base conclusions but the uniformity in satisfactory therapeutic results and absence of evidence of harm after a period of years are significant. The condition suggesting a roentgen study of the thymus consisted of sudden, alarming attacks of dyspnea with cyanosis in infants who were otherwise free from illness.

All patients in whom there was a possibility of physical or mental impairment were excluded from the study, even though the symptom-complex suggested a thymus involvement. In all, the clinical diagnosis was verified by a radiologist and the treatment carried out under his supervision.

The accompanying table was compiled from questionnaires sent to all parents whose children had been subjected to roentgen study and therapy at our suggestion; greatly to our disappointment but 27 replies were received. It will be observed that in 21 the age range at the time of treatment was less than twelve months. Among the 6 over one year of age an involvement of the thymus was suggested in 5 because of repeated attacks of idiopathic croup with high grade cyanosis. The boy aged seven years was seen in consultation with the family physician. A diagnosis of pertussis had been made but the coughing paroxysms continued beyond the possible duration of a pertussis. Roentgen examination of the thymus gland was carried out revealing a greatly enlarged thymus; under roentgen therapy the seizures rapidly subsided.

Table 1 shows, in addition, the age at which roentgen therapy was administered, the present age, weight and height of the child as well as his present mental and physical condition. It will be observed that at the present age, the weight and height according to Engelbach exceeds the average weight and height standards of children of similar ages with the exception of 2 patients, who were slightly under height for age.

TABLE I

| Sex | Approximate Age yr. | Weight lb. | Height in. | Age When Treatment Began | Present Mental and Physical Development |
|---|---|---|---|---|---|
| M | 14 | 92 | 59½ | 7 yr. | Normal |
| F | 13 | 94 | 59 | 27 mo. | Normal |
| F | 11 | 92 | 61⅝ | 3 yr. | Normal |
| F | 11 | 102 | 58½ | 8 wk. | Normal |
| F | 11 | 87½ | 57½ | 12 wk. | Normal |
| M | 10 | 74 | 55⅝ | 7½ mo. | Normal |
| F | 10 | 70 | 55⅛ | 7 mo. | Normal |
| M | 10 | 106 | 56 | 4 yr. | Normal |
| M | 10 | 58 | 55 | 21 mo. | Normal |
| F | 10 | 90¼ | 58½ | 13 wk. | Normal |
| F | 10 | 80 | 56 | 12 wk. | Normal |
| F | 10 | 75 | 56½ | 10 wk. | Normal |
| M | 9 | 50 | 51 | 6 wk. | Normal |
| M | 9 | 56¾ | 50⅜ | 6 mo. | Normal |
| F | 9 | 63 | 56 | 9½ mo. | Normal |
| F | 9 | 79 | 55¼ | 11 wk. | Normal |
| F | 9 | 73 | 53½ | 4 wk. | Normal |
| M | 8 | 71½ | 53½ | 5 mo. | Normal |
| M | 8 | 59 | 49¾ | 10 mo. | Normal |
| M | 8 | 65 | 49 | 4 wk. | Normal |
| M | 8 | 54 | 48½ | 14 wk. | Normal |
| F | 7 | 47 | 47 | 10 mo. | Normal |
| F | 7 | 70 | 53 | 4 mo. | Normal |
| M | 61 mo. | 50 | 45⅝ | 18 mo. | Normal |
| M | 48 mo. | 43 | 43 | 5 mo. | Normal |
| M | 39 mo. | 42 | 40¼ | 15 wk. | Normal |
| M | 26 mo. | 33 | 35 | 10 wk. | Normal |

Assuming that the diagnosis of thymus involvement on my part and that of the radiologist were in error, that the relief of symptoms was coincidental, we cannot deny that roentgen therapy was carried out. These patients were all under my personal

observation during the period of treatment and later the clinical results were eminently satisfactory, and the parents' report fails to show any damage to the physical or mental development.

Five sudden deaths in apparently normal infants under my observation, 2 of whom were autopsied and showed a massive thymus, is the explanation of our practice for many years to roentgenograph the thymus gland in all infants and children who come to us because of convulsions, habitual croup, laryngeal spasm or any condition suggesting respiratory obstruction. *Five cases of sudden death in private practice* are quite sufficient for a life time and it would require a better argument than I have seen in the voluminous literature that has appeared on the thymus gland to divert me from this course.

With one or two exceptions the roentgen therapy was applied by Dr. Lewis Gregory Cole and Dr. Arthur S. Unger of New York. Dr. Cole's technique is as follows:

Three treatments are given approximately one week apart, the first one over the anterior aspect of the chest and then a right and left projection including the region of the thymus. Each treatment is three minutes long with 5 ma., making 15 ma-min. per treatment. The kilovoltage which we have used is approximately 140, or, to be more exact, a 9-inch spark gap. The distance from the focal point of the tube to the skin is 10 inches and we have used a 3 mm. aluminum filter.

Dr. Unger's technique.

Two areas are treated: anterior thymic region; posterior thymic region. 178 kv.; 4 ma.; 50 cm. distance; filter 0.5 mm. Cu plus 1 mm. Al; size of field 6×8 cm.; time per treatment 5 min.; 35 r per treatment.

The cases are divided into 3 groups:

1. In the first group with moderate enlargement of the lateral lobes and no posterior enlargement, 3 treatments would be given. The second treatment at the interval of one week and the third treatment ten days to two weeks.

2. In the second group, where enlargement of both lateral lobes and posterior enlargement of the thymus are present, and the symptoms are rather severe, that is, the holding of the breath with marked blueness following the spasm, the second treatment is given at intervals of three days instead of one week, and the third treatment in a week. These cases probably need fourth and fifth treatments at intervals of ten days to two weeks.

3. The third group comprises those cases in which the enlargement of the lateral lobes persists and require anywhere from six to eight or ten treatments at intervals of ten days to two weeks.

In this study our conclusions, assuming that the child is a normal individual, are in accord with those of Polk and Rose* in that thymic irradiation in infants and young children produces no retardation of physical growth or mental development.

* Polk, D. S., and Rose, E. K. Late effects of irradiation of the thymus. Am. J. Roentgenol. & Rad. Therapy, 1936, *36*, 498–502.

# THE EFFECT OF ROENTGEN RAYS ON TUMORS IN ANIMALS TREATED BY PROLONGED CONTINUOUS EXPOSURE OF ENTIRE BODY*

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HEUBLEIN in 1932 and Craver and MacComb in 1934 described the treatment of tumors by continuous irradiation of the entire body. Their work was confined to certain neoplastic diseases in man which becoming widely disseminated early in their course are not effectively controlled by the usual local treatment.

The purpose of the present report is to describe the results of continuous irradiation of the entire body on the growth and transferability of an experimental mouse tumor, using the same apparatus employed by Heublein, at the Memorial Hospital. The host and tumor tissues are treated together.

Murphy, Nakahara and Sturm, Murphy and Nakahara, and Murphy and Morton have shown that irradiation of the entire body of mice with small doses of soft roentgen rays increases resistance to subsequent tumor transplants. The resistance is said to be associated with an increase in the lymphocytes.

Caspari found a late appearance of increased resistance to Ehrlich's carcinoma following small doses of roentgen rays, while large doses over the entire body caused a loss of immunity.

Mottram and Russ found that the natural immunity of rats to Jensen's rat sarcoma was lost by treatment with large doses of roentgen rays.

Westergaard gave daily doses of roentgen rays for nine days to mice with Jensen's carcinoma and found that tumor growth was inhibited and the life of the animals prolonged.

Russ, Chambers and Scott treated rats with small daily doses of twelve seconds each over the entire body. The treatments were begun before transplantation of the tumor and continued for four to eight weeks. There was a reduction in the rate of growth of the tumors in the irradiated group as compared with the controls, as well as an increase in the number of tumor regressions.

Kok and Vorlaender used hard roentgen rays in single doses. They treated the entire body of mice before transplantation with Ehrlich's carcinoma, at the time of transplantation and shortly after the appearance of the tumors. They report that irradiation over the entire body was just as effective in controlling tumor growth as was the local treatment of the tumors. In the latter instances the rest of the body was shielded.

Juul, in extensive experiments with transplantable carcinoma and sarcoma in mice, has shown that one may obtain a more favorable proportion between the injury to normal tissues and the effect on mouse tumors by employing a protracted irradiation (fractional doses) than by giving the radiation in a massive dose. He finds that the saturation method is preferable to the simple fractional method.

## EXPERIMENTAL METHODS

With the Heublein method one can treat with hard roentgen rays at a long distance, so that all parts of the body receive nearly the same dose of radiation. A roentgen machine was operated approximately twenty hours a day. The experimental animals were placed in a treatment ward in

* This investigation has been aided in part by a grant from the National Research Council through the Committee on the Effects of Radiation upon Living Organisms.

cages suspended by a wire cable 12 feet from the source of radiation, approximately 59 inches above the floor and directly in the beam of roentgen rays. They were in galvanized metal cages, 9×6×7 inches, with wire tops. Glass covered the long side of the cage facing the roentgen tube.

The experimental tumor was mouse sarcoma No. 180, kindly supplied by the Crocker Laboratory. It usually grows rapidly, killing the host within four to five weeks. The host animals were selected from a closely inbred strain of albino mice.

The tumor was transplanted by trocar into two sets of mice, A (the test group) placed immediately into the roentgen beam after each transfer, and B (the control) returned to the laboratory. After irradiation of from two to five weeks' duration the animals were removed and new tumor tissue obtained for carrying on the tumor to the next generation. The untreated control tumors were transferred into new hosts on the same days that the transfers were made for the treated tumors.

In each generation a third group of mice (Group C) was studied. Tissue of the irradiated tumors was placed in 5 host animals and instead of being returned to the treatment ward they were placed with the controls in the laboratory.

Conditions in the treatment ward prevented more than 5 tumor-bearing animals from being treated at one time. After the treatment period the animals were kept in the laboratory until either they succumbed to the tumor or the tumor completely regressed.

The tumors were measured weekly and histological sections were saved from each generation of tumor transplant.

## EXPERIMENTAL RESULTS

*Irradiation of the Tumor through Twenty Generations.* Table 1 summarizes the results showing the average size of treated and control tumors at the end of irradiation in each generation, the number of animals treated, days of continuous roentgen exposure, total roentgens, failures to transplant, number of regressions and the survival period of the tumor-bearing animals.

The period of nearly continuous roentgen treatment, through twenty generations of tumor transplants, was sixteen months, except for four weeks after nine days of treatment in the seventh generation. Before and after this period the treatment was practically continuous.

The first tumors were irradiated for two weeks, those of the second generation for four, and the third to the sixth generation for five weeks, respectively. Because of the difficulty in obtaining viable control tumor tissue after a growth of five weeks, due to the tendency of the tumors to become necrotic, the time of treatment in the later generations was reduced to three weeks.

The r per treatment varied from 225 to 2,100, the average for the last eleven three-week treatments being 975 r. The total for all treatments was 23,475 r, but no one generation of tumor cells received more than 2,100 r and the total dose was distributed over a period of sixteen months. No summation of irradiation effects from one generation to another was noted in the behavior of the experimental tumor throughout the successive treatments, as shown in the results which follow. It appeared that in each generation the restraining influence of the roentgen rays ceased when the host animals were sacrificed and a new generation of tumor transplants was started from the old irradiated tumor.

(*a*) *The survival period of host animals.** The average number of days that tumor-bearing animals lived after transplantation was for those irradiated, fifty-seven days; for controls, forty-nine days (see Table 1).† In two generations the survival periods of both groups are approximately the same. In five no comparisons are possible, as

* The groups are A and B. Group C animals have been omitted in order to simplify Table 1. The average tumor growth in Group C is mainly intermediate between the sizes of the test group receiving continuous irradiation and of the controls. The total average survival period for Group C host animals is fifty days.

† When the distribution curves for survival periods are plotted, the mean survival period for 45 irradiated tumor-bearing host animals was from fifty to sixty days and for 48 controls from forty to fifty days.

TABLE I

RESULTS FOR THE TREATMENT OF IRRADIATED AND CONTROL TUMORS THROUGH TWENTY GENERATIONS OF TRANSPLANTATION

| Generation | Group | Days of Treatment | r per Treatment | No. Animals | No. Negative Tumor Transplants | No. Tumor Regressions | Average Size Tumor in mm. at End of Treatment | Average No. Days Surv. Transp. |
|---|---|---|---|---|---|---|---|---|
| 1 | Treated | 14 | 750 | 2 | | | 8×11× 5 | 82 |
| | Control | | | 2 | | 1 | 9× 6× 4 | * |
| 2 | Treated | 28 | 1500 | 5 | | | 17×15× 8 | 57 |
| | Control | | | 5 | | 1 | 19×18×10 | 34 |
| 3 | Treated | 35 | 1875 | 5 | | 2 | 12×11× 5 | 74 |
| | Control | | | 5 | | | 31×24×16 | 44 |
| 4 | Treated | 35 | 1800 | 5 | | | 19×16× 8 | 50 |
| | Control | | | 5 | | | 24×21×11 | 49 |
| 5 | Treated | 35 | 1650 | 5 | | 1 | 13×12× 4 | 46 |
| | Control | | | 5 | | 1 | 27×21×11 | 35 |
| 6 | Treated | 35 | 2100 | 5 | | 2 | 12×10× 4 | 51 |
| | Control | | | 5 | 1 | 1 | 22×20×12 | 31 |
| 7 | Treated | 9† | 450 | 5 | | 1 | 6× 6× 3 | 56 |
| | Control | | | 5 | 3 | 1 | 4× 5× 1 | |
| 8 | Treated | 29 | 1950 | 5 | 1 | 2 | 13×12× 7 | |
| | Control | | | 5 | | | 21×17×16 | 42 |
| 9 | Treated | 21 | 1050 | 5 | | 1 | 11×10× 4 | 56 |
| | Control | | | 5 | | 1 | 6× 6× 2 | 71 |
| 10 | Treated | 21 | 975 | 5 | 3 | 1 | 4× 5× 2 | |
| | Control | | | 5 | | | 8× 9× 3 | 55 |
| 11 | Treated | 21 | 1425 | 4 | | 1 | 6× 6× 3 | 39 |
| | Control | | | 5 | 1 | | 14×12× 6 | 30 |
| 12 | Treated | 21 | 900 | 5 | | | 11×10× 3 | 58 |
| | Control | | | 5 | 3 | | 11× 9× 4 | 63 |

* Survival period not given indicates that a single tumor survived and was used for transplanation.
† Note break in treatment, see text.

TABLE I—*Continued*

| Generation | Group | Days of Treatment† | r per Treatment | No. Animals | No. Negative Tumor Transplants | No. Tumor Regressions | Average Size Tumor in mm. at End of Treatment | Average No. Days Surv. Transp. |
|---|---|---|---|---|---|---|---|---|
| 13 | Treated | 21 | 900 | 5 | 1 | | 12×10× 4 | 48 |
| | Control | | | 10 | | 1 | 15×14× 7 | 44 |
| 14 | Treated | 21 | 975 | 5 | 2 | | 12× 9× 4 | 72 |
| | Control | | | 5 | | | 9× 9× 5 | 54 |
| 15 | Treated | 21 | 975 | 5 | | 1 | 12× 9× 4 | 65 |
| | Control | | | 5 | | | 14×11× 7 | 70 |
| 16 | Treated | 21 | 1050 | 5 | | 2 | 9× 7× 4 | 60 |
| | Control | | | 5 | | 1 | 13×12× 8 | 43 |
| 17 | Treated | 21 | 900 | 5 | 3 | 1 | 5× 5× 2 | |
| | Control | | | 5 | | 2 | 10×10× 6 | 62 |
| 18 | Treated | 21 | 975 | 8 | 3 | | 3× 3× 2 | 60 |
| | Control | | | 5 | | 1 | 11×10× 5 | 69 |
| 19 | Treated | 21 | 1050 | 8 | 1 | | 12× 9× 4 | 44 |
| | Control | | | 5 | | | 15×13× 7 | 43 |
| 20 | Treated | 7 | 225 | 7 | 1 | | 5× 6× 3 | 57 |
| | Control | | | 5 | | | 11×11× 7 | 52 |

failures to transplant and tumor regressions eliminated one group in each generation. In the ninth, twelfth, fifteenth, and eighteenth the controls, on the average, lived longer than the treated hosts, but in nine generations the reverse is true. These results, however, are based on averages from relatively small numbers.

The reduction in numbers was due to tumor regressions and to those animals in which the tumors failed to grow.

(*b*) *The effect of irradiation on the average size of the irradiated and the control tumors.* The effect of continuous roentgen irradiation on the average size of the tumors at the end of treatment in each generation shows the following: In fifteen generations the treated tumors were smaller than the controls, in three the sizes were similar, while only in the ninth and fourteenth generations were the average sizes of the control tumors smaller than the averages of the irradiated tumors.

(*c*) *Detail of first three generations irradiated.* The results for the first three generations are given in detail in Chart 1. Animal No. 44 shows an irradiated tumor that did not grow during roentgen treatment and but very slowly until forty-nine days past inoculation, the animal living until the eighty-second day.

The results for the second generation

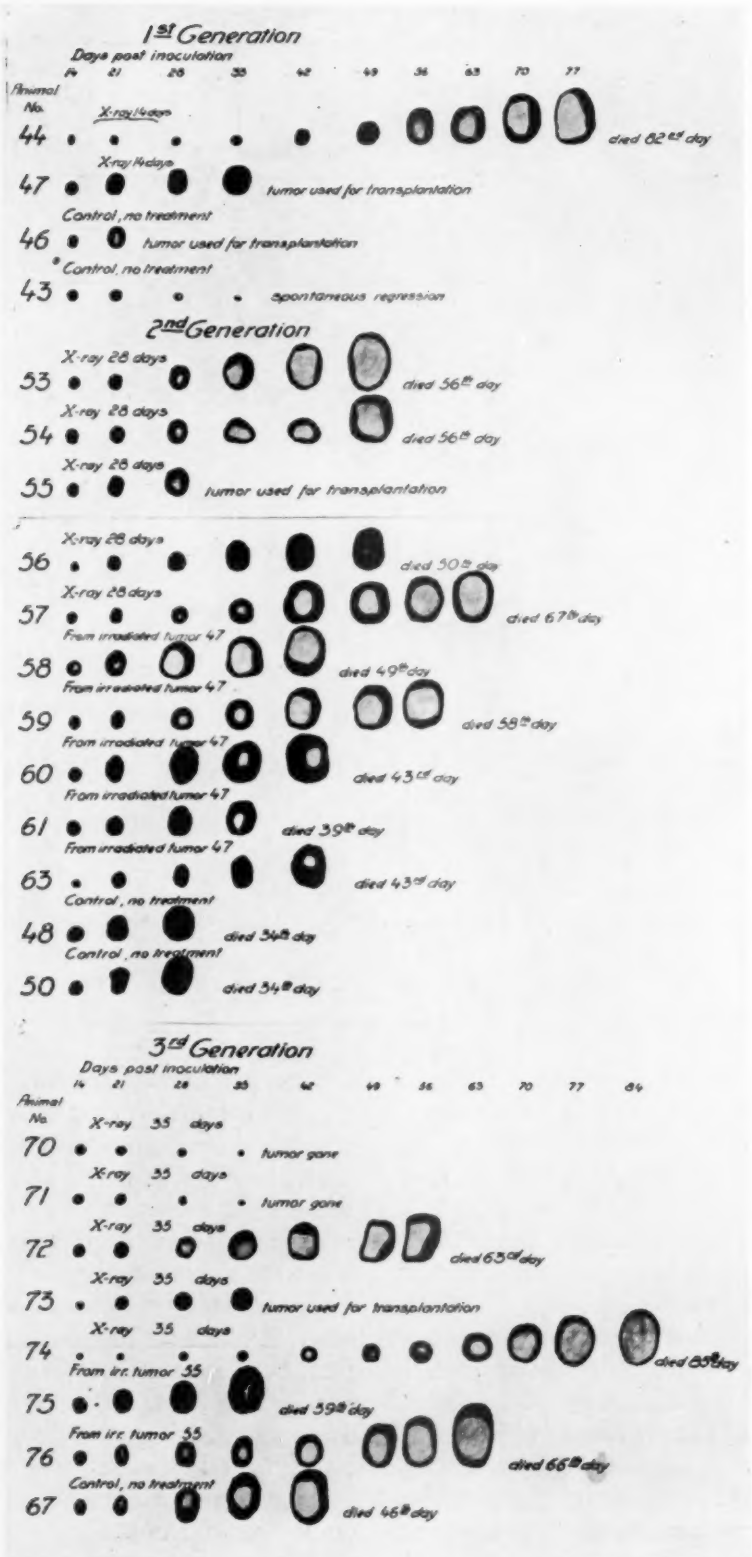


Chart 1. Growth of mouse sarcoma No. 180, subjected to continuous roentgen irradiation. The first three generations are shown with controls for comparison.

show the three groups, previously described: Group A, irradiated twenty-eight days (No. 53 to 57); Group B, typical controls (No. 48 and 50) and Group C, tumors (from treated animal No. 47) that received no roentgen exposure after transplantation.

The irradiated tumors grew relatively slowly, the hosts living fifty, fifty-six, fifty-six, and sixty-seven days after tumor inoculation, respectively. The average survival period of 4 controls (one regressed) was thirty-four days.

The possible effect of the fourteen days of treatment to tumor No. 47 may also be seen in the tumors of Group C (No. 57 to 61). The average survival period was forty-six days post inoculation, one host living as long as fifty-eight days.

The 5 third generation tumors treated with almost continuous roentgen irradiation for thirty-five days are No. 70 to 74. No. 70 and 71 remained stationary in size for the first week of irradiation, but had nearly disappeared at the end of the treatment. Tumor No. 72 grew slowly during treatment and the host lived for sixty-three days post inoculation. Tumor No. 74 grew very slowly during and after treatment. The host lived for eighty-five days, which was almost twice the average survival period of the controls for this generation.

The average sizes of irradiated tumors of the fourth, fifth and sixth generations were also appreciably smaller than the controls when measured at the end of irradiation. The seventh generation treatment was interrupted and results for this group are not conclusive, but of the remaining thirteen generations in only two (ninth and fourteenth) were the treated tumors larger than the controls, and in one generation (twelfth) the average sizes of the two groups were approximately equal.

(*d*) *Failure to transplant and tumor regressions.* Fifteen irradiated tumors (14 per cent) failed to grow when transplanted into 104 host animals of Group A. Seventeen regressions (17 per cent) occurred in 102 controls and 17 (18 per cent) in the 93 animals of Group C (irradiated as described above). The failures to transplant were distributed through a wide range of generations for all groups. The relatively high percentage in the controls may be due to the delay in transferring the tumor as previously described.

TABLE II

RECORD OF TUMOR TRANSPLANTS, EXPOSED TO CONTINUOUS ROENTGEN IRRADIATION, THAT SHOWED MARKED REGRESSION UNDER TREATMENT AND FINAL ABSORPTION

*Animals from Group A*

| Animal No. | Generation No. | Weeks of Irradiation | Regression Complete in Weeks Post-transplantation |
|---|---|---|---|
| 70 | 3 | 5 | 6 |
| 71 | 3 | 5 | 6 |
| 115 | 5 | 5 | 6 |
| 132 | 6 | 5 | 6 |
| 190 | 10 | 3 | 3 |
| 288 | 16 | 3 | 4 |
| 289 | 16 | 3 | 3 |
| 302 | 17 | 3 | 4 |
| 131 | 6 | 5 | 8 |
| 146 | 7 | 1* | 5 |
| 162 | 8 | 4 | 7 |
| 164 | 8 | 4 | 7 |
| 176 | 9 | 3 | 5 |
| 206 | 11 | 3 | 7 |
| 274 | 15 | 3 | 5 |

* Note break in treatment series, see text.

A study of individual records of the irradiated tumors shows variation in types of growth. One is exemplified by the transplants in host animals No. 70 and 71 (see Chart 1). The tumors grow slowly to the fourteenth day post inoculation, regress and are practically absorbed two or three weeks later on the completion of the roentgen treatment, (see Table II). There are 15 tumors in this group. The table shows the number, generation of tumor transplant, irradiation per generation and the interval following transplantation when tumor regression was complete. The tumors in this group show pronounced regression associated with roentgen treatment of the entire body of the host. In approximately half of this group the absorption of the tumors

TABLE III

RECORD OF TUMOR TRANSPLANTS SHOWING NO PALPABLE GROWTH FOR THREE TO FIVE WEEKS AFTER INOCULATION (WHEN TUMORS WERE EXPOSED TO CONTINUOUS ROENTGEN TREATMENT) BUT SHOWING RAPID RESUMPTION OF GROWTH ON REMOVAL FROM THE TREATMENT WARD

*Animals from Group A*

| Animal No. | Generation No. | Weeks of Irradiation (No Apparent Growth of Transplant) | Animal Died Weeks Post-transplantation of Tumor |
|---|---|---|---|
| 134 | 6 | 5 | 8 |
| 238 | 13 | 3 | 9 |
| 275 | 15 | 3 | 11 |
| 318 | 18 | 3 | 8 |
| 332 | 18 | 3 | 7 |
| 336 | 19 | 3 | 7 |

was practically completed by the end of the period of irradiation (see first 8 animals of Table II). In the remaining 7 tumors the response to generalized irradiation is similar to the above, except that the tumors persisted for two to three weeks beyond the completion of treatment before finally being absorbed.

(*e*) *Failures to grow during irradiation.* In Table III are records for 6 tumors that show still more marked reaction to continuous roentgen exposure. There were no palpable tumor transplants in this group throughout the roentgen treatments. One was irradiated for five and the others for three weeks, respectively. The tumor in No. 318 showed no signs of growth until fourteen days after the completion of three weeks of irradiation. It then grew and killed the host at the end of a total of eight weeks post inoculation. Tumors in animals No. 134, 238 and 336 showed slight but appreciable resumption of growth in the first week following removal from the roentgen-ray ward. The growth was progressive and killed the animals in the eighth, ninth and seventh week of the experiment, respectively. The tumor in No. 275 showed no growth for the twenty-one days of irradiation, but in the first week after irradiation the tumor grew rapidly to 9×8×5 mm., finally reached a large size and killed the animal at the eleventh week. The tumor in animal No. 332 showed a marked resumption of growth apparently associated with release from the growth restraining influence of generalized roentgen irradiation. The tumor, not palpable at the end of three weeks of treatment, apparently grew to 12×11×2 mm. in the first seven days post-treatment. The rate of growth was rapid, the tumor reached a large size and killed the animal at the end of the seventh week.

(*f*) *Regressions in tumors of Group C.* Seven animals of Group C showed tumors that grew slowly for a time but finally regressed. They are shown in Table IV, which indicates the catalogue number of the hosts, the number of generations in which the tumor was exposed to roentgen rays in the preceding generations (as part of Group A), and the number of weeks following transplantation, at which the regression of the tumor was complete.

(*g*) *Retarded tumor growth in controls.* The ninth generation transplant of No. 189 showed no palpable growth for three weeks after transfer, reached a large size and killed the host at the tenth week. Two tenth generation transplants, No. 200 and 201, also failed to show appreciable growth for three weeks after transfer but then resumed activity and killed the host animals at the seventh week. Only these 3 controls

TABLE IV

RECORD OF TUMOR REGRESSIONS. TRANSPLANTS GROWN IN NON-IRRADIATED HOST ANIMALS. TISSUE FOR TRANSPLANTATION OBTAINED FROM TUMORS IRRADIATED IN PRECEDING GENERATIONS

*Animals from Group C*

| Animal No. | Generation No. | Regression Complete in Weeks Post-transplantation |
|---|---|---|
| 105 | 3 | 6 |
| 135 | 5 | 3 |
| 166 | 7 | 5 |
| 168 | 7 | 5 |
| 195 | 9 | 8 |
| 242 | 12 | 5 |
| 343 | 19 | 6 |

out of 102 animals showed this delayed growth.

*Study of the Tumor for Eight Generations after the Completion of the Roentgen Treatments.* The test and the control tumors were continued from the twenty-first to the twenty-eighth generation, inclusive, with no roentgen treatment to either group. No delayed irradiation effects were noted as a result of treatment in previous generations. Transfers were made every twenty-one days. Forty tumors descending from Group A, and 46 controls were studied. In the first group the results show 5 transplants failing to grow, 2 regressions, 2 animals that died of pneumonia and an average survival period for 22 animals of fifty-one days. In the control group 10 tumors failed to grow, 7 regressed, 2 animals died of pneumonia and the average survival period for 16 animals was fifty-six days.

*General Data.* Frequent weighings of the irradiated animals showed no apparent loss in body weight as a result of roentgen treatment. The general health of the treated host animals remained good.

A histological study of the sarcoma tissues revealed no apparent change in the structure of the tumors receiving the roentgen treatment. No accumulation of pathological effects was noted after exposure to continuous roentgen irradiation over successive generations of transplantation.

Tissue cultures were made from the tenth, eleventh, thirteenth, fourteenth, sixteenth, eighteenth and nineteenth generations. Again, no apparent structural changes were observed as a result of the irradiation and no differences were noted in the motility of the individual cells as judged by motion picture records.

## DISCUSSION OF RESULTS

Continuous irradiation of the entire body of mice by relatively low intensity, hard roentgen rays given at a long distance produced apparently very little effect on the general physical condition of the animals. Their health remained satisfactory and no loss in weight occurred even after five weeks of treatment. The experimental setting was such that there was a relatively uniform distribution of radiation throughout the tissues undergoing treatment.

A single strain of transplantable mouse tumor, sarcoma No. 180, has shown continuous growth through twenty generations of transfer into host animals over sixteen months of almost continuous roentgen exposure. No histological change was noted in the character of the tumor following the treatment. The same tumor was continued for five additional series of transfers without treatment and still no latent changes were noted in the tissues.

The roentgen treatment, however, reduced the rate of the growth of the tumors in the irradiated host animals, but after removal from the roentgen field a resumption of growth activity was noted. In 6 instances the tumor transplants showed no apparent growth during the entire time of roentgen exposure, in one case for five weeks and the others for three weeks, respectively. It is of interest that, notwithstanding this prolonged retardation in growth activity, after removal from the roentgen beam all the tumors resumed their neoplastic tendency and eventually caused the death of the hosts. The roentgen effect appeared to be limited to the actual period of exposure and no summation of effects was noted under the conditions of the experiment. The restraining influence built up in one generation did not appear to be carried over into the next generation by the piece of irradiated tumor tissue that was used for transfer purposes. It is possible that the restraining influence associated with the roentgen treatment of the experimental tumors in host animals was due to a generalized reaction of the tissues of the host animal rather than to a direct effect on the tumor tissue itself, but the results of the present experiment are not conclusive in this regard. When new untreated host animals were used as recipients in each generation it was impossible

for this restraining influence to be active for any length of time.

## CONCLUSIONS

(1) Mouse sarcoma No. 180 has grown in a roentgen field for a nearly continuous period of sixteen months, through twenty generations of transplantation.

(2) With an intensity of radiation (hard roentgen rays given at a relatively long distance) of 2.72 r per hour, measured in air, the total treatment to the original tumor cells and to their descendants was approximately 31 S.E.D., or somewhat over 23,000 r in a period of sixteen months.

(3) The continuous irradiation of the entire body of host animals, usually from three to five weeks, has resulted in an increase in the life of the tumor-bearing animals, associated with a retardation in the rate of growth of the tumors.

(4) The tumor transplants in the irradiated group frequently showed a resumption of growth activity on removal of the animals from the roentgen field.

(5) No summation of roentgen effects was noted in the biological activity of the tumor under the conditions of the experiment. No apparent histological change was seen following the treatment. Tissue culture study of the sarcoma showed apparently as active cell movement in the treated as in the control culture, as recorded by moving picture records.

I wish to acknowledge my indebtedness to Mr. John Jacksen for his assistance in the details of the experiment.

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Vol. 40, No. 3

# SOME EFFECTS OF RADIATION ON OIL*

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A GREAT variety of chemical reactions can be produced by radiation. Oxidation of both inorganic and organic compounds seems to be the most usual occurrence, but reduction results in some instances. Different types of radiation may have different effects and must therefore be considered separately. Many studies have been made of the effect of roentgen rays, and correlation between the amounts of ionization and reaction has been found. One kiloroentgen ionizes in air one part in about 10,000,000 parts of the molecules. In liquids the ionization should be of the same order of magnitude and the chemical change produced is usually of this magnitude except when chain reactions occur. It is often difficult to detect such small changes. In very weak aqueous solutions a relatively large portion of the solute may, however, be affected. The amount changed seems to be relatively independent of the concentration but proportional to the ionization in the solvent. The percentage change of the solute is therefore greater the more diluted it is. This is in agreement with the assumption made by Fricke[1] that the primary effect is on the water and that activated water molecules react with the solute. Ionization may not be necessary for the reaction but when high energy radiation is used it is possible that the number of activated molecules does not exceed the number of original ions to a great extent. By means of weak solutions it has been possible to study a great number of reactions. It is, however, also of interest to study the effect on pure liquids, and the problem then is how to measure such a small change which may amount to one part in 100,000 if the molecules are relatively large. It occurred to us that the spreading of oil drops on water could be used for this purpose. Pure saturated hydrocarbons with long chains form drops or lenses on water, whereas oxidized hydrocarbons, and particularly fatty acids such as stearic acid, spread out and tend to form monomolecular films if the water surface is large compared with the amount of acid used. Langmuir[2] has shown that if very minute amounts of such acids are dissolved in oil, the drops spread to an extent proportional to the number of acid molecules present, as these molecules diffuse to the interface forming a monomolecular layer on which the oil spreads. If oil is oxidized to a certain extent by heat similar spreading occurs when drops are placed on water. It seemed plausible that a small fraction of the molecules in an oil drop on water should be oxidized if exposed to roentgen rays and that as a consequence the drop would spread. Assuming an average molecular weight for the oil to be around 200, one kiloroentgen might be expected to ionize one part in 1,000,000 parts of the oil and with 10 kiloroentgens enough molecules should be oxidized to effect a measurable increase in the diameter of the drop. Preliminary experiments[3] substantiated this assumption and some detailed studies were started. Several factors influence the spreading and it is evident that special precautions have to be taken in order that somewhat consistent results may be obtained. Small impurities in the water, particularly on the surface, may change the results. Calcium is particularly apt to prevent spreading and a monomolecular film of organic compounds interferes completely with the effect. The hydrogen ion concentration has a great influence and must be controlled; usually alkaline water is used.

A study of the effect of radiation on oil should be of particular interest as such changes may be of importance in the bio-

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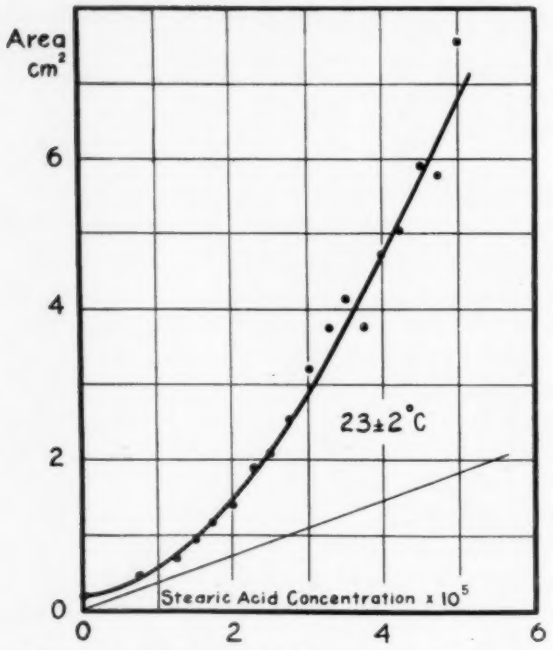


FIG. 1. Relation between the maximum areas of oil lenses on 0.01 N NaOH in water and the stearic acid concentration of the oil.

logical field. It may have something to do with the reaction of tissues and particularly with the effect of radiation on the cell membranes.

In the experiments, the following procedures were used unless otherwise mentioned. One hundredth normal sodium hydroxide solution was made with distilled water. This alkaline water was poured into Petri dishes and a drop of oil placed on the surface in each dish. The oil was collected either with a capillary glass tube or a tungsten wire from which it was permitted to drop to the surface. The size of the drop was proportional to the diameter of the capillary or wire. In the experiments reported here each drop had a mass of about 8.7 mg. The water surface became covered with a film very easily. The presence of this film was tested by powdering the surface with sulphur dust. Unless this powder was easily blown to the edge a film was present and had to be removed. The powder was decanted before the oil was dropped on the surface. The diameter of the drop was measured to within 0.1 mm. by means of a telescope and scale which was placed on one side of the dish while a strong light illuminated the surface from the opposite side. Both light source and telescope were placed at a higher level than the dish. The diameter of the dishes, about 10 cm., was always several times larger than the maximum diameter of the drops. During irradiation the containers were placed on a large block of beeswax. A heavy mineral oil with the trade name "Bacol" was used.

Some measurements were taken of oil drops containing a known amount of stearic acid and palmitic acid respectively in order to obtain an idea of how such drops behave. It was found that the drops increased in size for a short interval of time and then contracted again as the acid left the drop and spread on the water surface. The effect is greatly influenced by the hydrogen ion concentration and also by the temperature of the water. When a 0.01 normal sodium hydroxide solution is used and kept at a temperature of about 23° C. the maximum diameter is reached in from one to twenty minutes. This time interval is dependent upon the concentration of acid in the drop, being shorter the higher the concentration. When the maximum

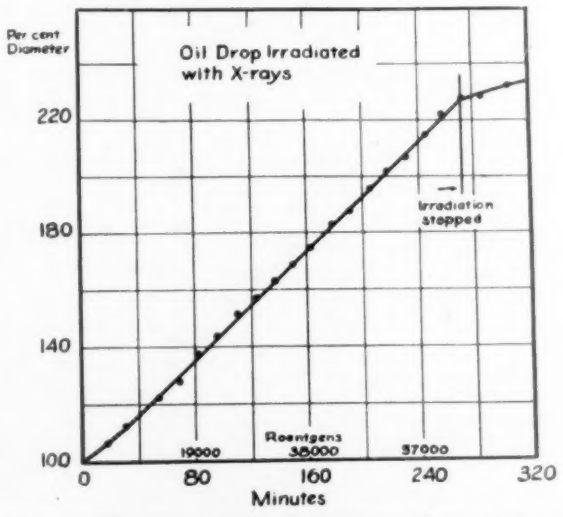


FIG. 2. The growth of the diameter of an oil drop (on the surface of water containing 0.01 N NaOH) during and after irradiation with roentgen rays at 100 kv. (peak), 5 ma., 20 cm. distance from target, no filter.

diameter was recorded and the calculated area was plotted against the concentration of stearic acid, the curve in Figure 1 was obtained. The straight line below the curve indicates what the area should have been if the stearic acid molecules had formed a closely packed monomolecular layer with each molecule occupying an area of $20 \times 10^{-16}$ cm.$^2$, the value given by Langmuir. Evidently the film spreads out to as much as four times its minimum size. No greater details of the experiments with stearic acid will be given as they serve here only to emphasize the similarity and differences in behavior of irradiated oil and oil solutions of stearic acid.

Two methods of irradiating oil have been used. The first experiments consisted in irradiating oil drops after they had been placed on the water surface. Figure 2 shows how a drop grows while being irradiated with roentgen rays. The diameter of the drop is plotted against the dose. Several factors influence the growth and it must be considered accidental that the curve is almost linear. The drop continues to increase in size at a slower rate after the irradiation is stopped and gradually approaches a maximum; 100 kv., 5 ma., 20 cm. target-surface distance and no filter except a piece of black paper were used; half-value layer 0.8 mm. Al.

The second method has been to irradiate the oil in bulk. It was found that when a drop of such irradiated oil was placed on a water surface its area increased for some time toward a maximum which was greater the larger the dose of radiation. This method seemed more suitable for the present study and has been used the most. The roentgen rays were produced with mechanically rectified machines. The factors used for the "low voltage" were 100 kv. (peak), 8 ma., usually 30 cm. target-surface distance, no filter except a piece of black paper, thin-walled air-cooled tube, half-value layer 0.8 mm. Al, intensity 200 r per minute. The factors for the "high voltage" were 200 kv. (peak), 30 ma., 50 cm. target-surface distance, 1 mm. Al filter, thick-walled water-cooled tube, half-value layer 0.25 mm. Cu, intensity 169 r per minute. The oil containers consisted of pyrex test tubes of 1 mm. wall, 1.5 cm. in diameter and 14 cm. long. They were half filled with oil, closed with clean corks and irradiated while lying in a horizontal position on the beeswax block.

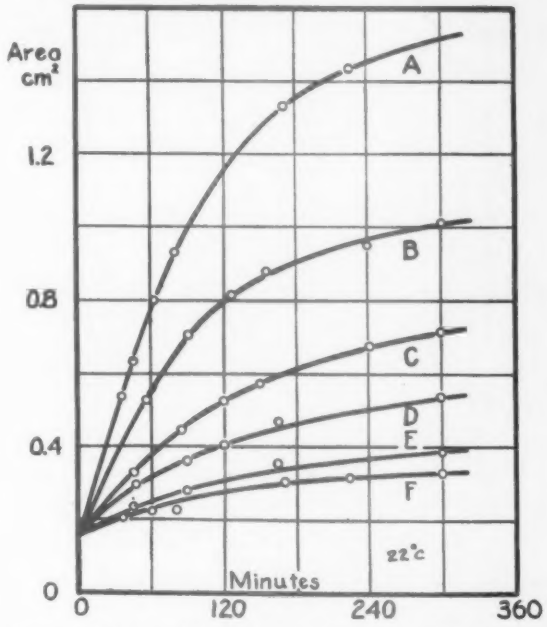


Fig. 3. Oil was irradiated in test tubes. The curves show the growth of the area of the oil lenses as a function of time after they were placed on the alkaline water. Curves *F*, *E*, *D*, *C*, *B* and *A* represent oils irradiated for 0, 80, 120, 180, 240 and 300 minutes respectively with roentgen rays at 200 kv. and twenty-four hours after irradiation.

The following experiment was made to obtain information about the growth of the drops after they were placed on a surface of alkaline water. Test tubes with oil were irradiated with high voltage roentgen rays for 0, 60, 120, 180, 240 and 300 minutes. Twenty-four hours later drops of oil from these tubes were placed on the water surface in separate dishes. Curves *F*, *E*, *D*, *C*, *B* and *A* in Figure 3 show the increase of the area for the respective drops during 300 minutes. After this length of time, the growth is rather negligible and the size finally remains unchanged for days if the surface is kept free from dust or other impurities. It has been found that the

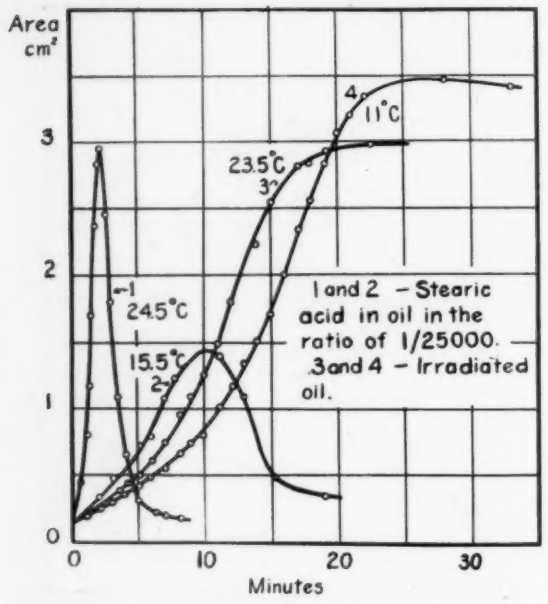


FIG. 4. Areas of oil lenses are given as a function of their time on alkaline water for oil containing stearic acid and for oil irradiated in test tubes. The growth is given for different temperature of the water.

growth rate depends upon the temperature increasing as the temperature is raised. The maximum value of area attained is, however, smaller at higher temperature probably due to a decrease of the surface tension of the water. The growth rate is slightly increased as the time interval elapsing between the irradiation and the formation of the oil lens is made greater, but the maximum area is not changed beyond experimental error. When the temperature is kept at about 23° C. it seems advisable to select as representative that value of the area which is obtained five hours after the lens has been formed. The original size of the area of the lenses weighing 8.7 mg. was in all the experiments about 0.2 cm.² and increased for the drops from the unirradiated oil to a little above 0.3 cm.² The area of lenses from oil receiving five hours of irradiation increased to about 1.5 cm.²

The difference in behavior between irradiated oil and oil containing stearic acid as well as the influence of the temperature is demonstrated in Figure 4. The rapid increase in the surface area of drops containing one part of stearic acid in 25,000 parts of oil after they have been placed on alkaline water is clearly shown in curve 1. After about two minutes the maximum area of 3 cm.² has been reached and then an equally rapid contraction begins. This is at a temperature of 24.5° C. The rapid spreading is evidently due to diffusion of acid to the oil-water interface, while the contraction results as the acid leaves the drop. With a temperature of 15.5° C., the growth for the same type of drop is much retarded. Curve 2 shows that a maximum area of about 1.4 cm.² is reached after ten minutes. The growth rate and the peak value of the area are evidently determined by the relation of diffusion and loss of acid. Drops from irradiated oil grow more slowly and remain stable after the maximum area finally has been reached. The heavier the roentgen dose, the faster the growth, and curve 3 shows that with a very heavy dose a maximum of about 3 cm.² may be reached after twenty minutes at a temperature of 23.5° C. Whatever substance is formed it probably diffuses slower to the oil-water interface than stearic acid, though a delay in the spreading may possibly be due to a chemical reaction between activated oil molecules and the water. The stability of the lenses after their maximum area has been reached indicates that the new molecules do not leave the oil. The growth rate is reduced as the temperature is lowered but the maximum value of the area is increased, probably, as has been mentioned, due to increase of the surface tension of the water. Curve 4 shows that a maximum value of the area of 3.5 cm.² was reached in about twenty-five minutes with the same type of drop as before at a temperature of 11° C.

Some measurements were made to obtain a relation between the dose of roentgen radiation and the final size of the lenses. It was considered advisable to measure the intensity of the total radiation under actual experimental conditions. A removable ionization chamber from a Victoreen roentgen

meter was inserted in a pyrex test tube of the type described, and this tube was kept in the same position on the beeswax block during the measurements as when the oil was irradiated in similar test tubes. The readings thus obtained have been used in plotting the curve in Figure 5, and are there referred to as "kiloroentgens" for lack of better nomenclature. The circles and the solid dots in the figure represent the final area of lenses obtained from oil irradiated with 200 kv. and 100 kv. roentgen rays respectively. Some irregularities were to be expected because the temperature varied between 20 and 24° C. and it is questionable whether the final diameter of the lenses had been reached in all instances. The dots fall, however, relatively close to the curve, and within experimental error there is no difference in action between the two types of rays used when the dose is measured as described. In order to obtain the roentgens as measured in air (without the pyrex tubes) the "roentgens" of the figure must be multiplied by 1.37 for the solid dots obtained at 100 kv. and by 0.76 for the circles obtained at 200 kv.

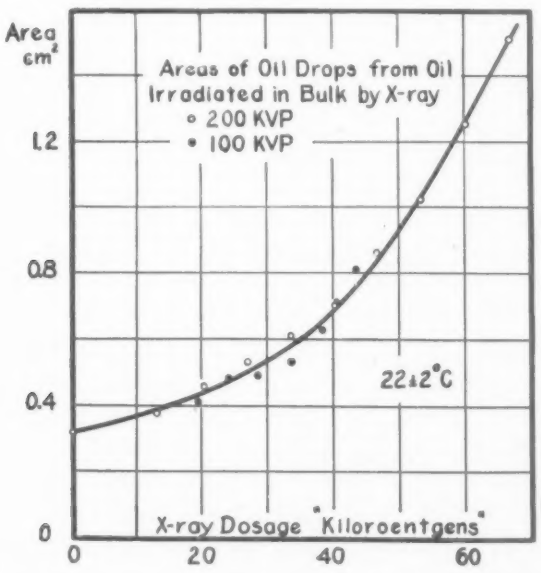


Fig. 5. The areas of oil lenses were determined after they had been on alkaline water for 300 minutes and about twenty-four hours after the oil had been irradiated in test tubes. The curve gives the areas as a function of the dose.

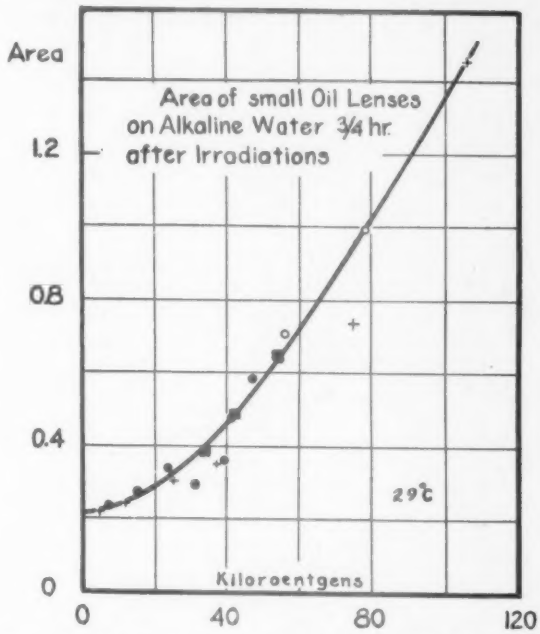


Fig. 6. The curve represents the growth of the area of oil lenses, which were irradiated on the water, as a function of the dose. Open circles, solid circles and crosses refer to irradiation with roentgen rays at 100 kv. and squares to irradiation at 200 kv.

Some measurements were also made of the final area obtained by drops irradiated after they had been placed on the surface of alkaline water. The areas were determined three-quarters of an hour after irradiation of the drops and had then almost reached its maximum value, as most of the growth took place during the irradiation. The results are summarized in Figure 6. The areas of the lenses obtained with 100 kv. roentgen rays are here plotted against roentgens as measured in air. The values are represented by dots, circles and crosses. The curve was fitted to these values. Afterwards drops were irradiated at 200 kv. with 27.2, 32.7 and 42.0 kiloroentgens respectively, and the value of the area for the one receiving 32.7 kv. was found to correspond to the area for the 100 kv. drops receiving 42 kiloroentgens. In other words, the effectiveness of the radiation at 200 kv. was 28 per cent greater than at 100 kv. The roentgen value for the other two drops was also increased by 28 per cent and their areas then were found to be such that the

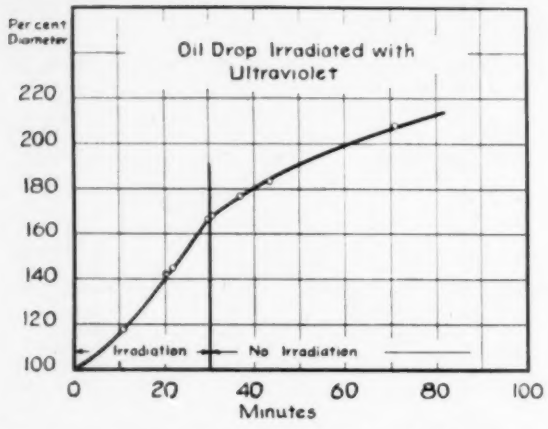


FIG. 7. The growth of the diameter of oil lenses on alkaline water as a function of time while irradiated with ultraviolet rays. Initial diameter of the drops was 5.3 mm.

corresponding square dots fell on the curve. Measurements with an r-meter showed the scattering for the conditions used at 200 kv. to be 55 per cent and for the conditions at 100 kv. to be 25 per cent. Thus for the same number of roentgens, as measured in air, the total dose at the surface was found to be 24 per cent higher at 200 kv. than at 100 kv. when measured with an r-meter, and 28 per cent higher when compared by means of the drops. These values agree within experimental error and therefore no difference in effectiveness on the oil drops with these two types of rays was found.

Two factors were varied considerably during the irradiation of the drops at 100 kv., namely, the distance and thereby the intensity. In plotting the curve these factors were reduced by means of the inverse square law to 30 cm. and 220 r per minute. This may be partly responsible for the relatively large fluctuations of the values obtained. No definite change of oil drop area with change of intensity was, however, found. The temperature was unfortunately not well controlled in these experiments and the heating effect at short distances was appreciable.

The measurements presented here were made while the method was being developed. The different factors involved were not accurately controlled and no great precision is claimed. Certain effects of the radiation can, however, be compared on the basis of the values obtained. The evidence is quite definite that oxidation is produced. Experiments which have recently been started indicate that the presence of oxygen, during the irradiation, is essential for the reaction causing the oil drops to spread. It is interesting to note that the effect per kiloroentgen was about twice as great when the oil was irradiated in test tubes as when drops were irradiated on the water. This difference can hardly be due to a small surface effect because no difference was noticed for roentgen rays of different hardness. It may be explained by assuming that a chain reaction takes place, with a link of the chain being partly removed by the water. The most evident value of the method concerned with the irradiation of oil drops is that it may be used to study effects at the surface as the drops are not over 4 mm. in thickness. No satisfactory explanation has as yet been found for the peculiar shape of the curves or the relationship between dose and lens area. Several factors are involved and further data are needed before a theory can be tested. The curve in Figure 5 can be represented by a simple exponential equation, with of course a deviation in the lowest portion.

Some experiments have been made with other types of radiation. It was found that $\beta$ rays from radium have an effect similar to roentgen rays. Ultraviolet radiation from a mercury quartz lamp is very effective. Only the rays of short wave length, evidently rays of wave length below 300 m$\mu$, are efficient in producing a spreading of the drops. With an ordinary Cooper-Hewitt type of lamp at 30 cm. distance from the water surface a drop spreads out to such a thin film that colored diffraction patterns can be seen. Figure 7 gives an idea of how rapidly the diameter of a drop increases when exposed at 30 and 60 cm. distance from the light source. When oil is irradiated in shallow dishes it is also rapidly affected.

It would be of interest to know what oxi-

dation products are formed but such tremendous dose is needed before enough material has been formed for analysis that it has not seemed advisable to attempt such investigations as yet. Some absorption measurements in the ultraviolet region have been made and increased absorption has been noticed in the short wave length region below 300 mμ in oil that had received a very heavy dose. This absorption is undoubtedly due to unsaturation and oxidation of the hydrocarbons.

## SUMMARY

1. A new method has been developed and used for the study of the effect of radiation on heavy mineral oil consisting of long chain hydrocarbons. An oil with the trade name "Bacol" has been used for these experiments.

2. The method consists in measuring the increase of the area of oil drops on alkaline water after the oil has been irradiated.

3. The method has been applied in two ways: either the oil was irradiated in test tubes, or drops of oil were irradiated after they had been placed on the water.

4. It has been shown that the effect can be produced with roentgen rays, β rays and ultraviolet rays of short wave length (below 300 mμ). This study refers mainly to roentgen rays

5. Curves have been made showing the growth of the drops on water during and after irradiation, and the relation between the maximum size and the dose of radiation. Drops from oil containing stearic acid have been studied to bring out the different behavior of such drops. The influence of the temperature has been shown

6. The effect increased with the dose, as measured by a roentgen meter, and no difference in effect was noticed between rays produced with 100 and 200 kv. (peak), (half-value layer 0.8 mm. Al and 0.25 mm. Cu respectively). When drops were irradiated on the water about twice as great a dose was required to obtain a certain growth as when the oil was irradiated in test tubes.

7. Oil irradiated with very heavy dosage shows a change in the absorption spectrum consisting in an increase in the regions below 300 mμ. This indicates oxidation and unsaturation.

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# CASE REPORT FROM THE MASSACHUSETTS GENERAL HOSPITAL, BOSTON, MASSACHUSETTS

*Edited by* JAMES R. LINGLEY, M.D.

CASE 111421. A white married housewife, aged thirty-one, entered the hospital because of lower abdominal pain of four years' duration. Twelve years previously she had had an appendectomy following which she began to have pain in her low back and flanks. Two months later she had a uterine suspension and removal of adhesions. She has had vague lower abdominal pain at irregular intervals since that time, particularly

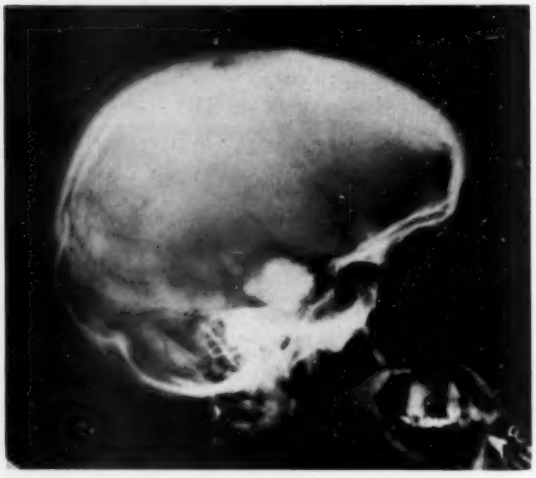

FIG. 1

after heavy work. Four years before entry she developed pain over the symphysis, nocturia, frequency and burning. Roentgen examinations of the spine, chest and pelvis in another hospital were negative. One year before entry she had sudden anuria and was unable to pass urine for several days. Five months before entry all the symptoms became worse. She had pain in the low back, both flanks, symphysis and both ears. Studies in another hospital, three months ago, were again negative. She had been very nervous with much headache and occasional diarrhea.

Physical examination revealed a short, stubby American female, not acutely ill. Visual fields and fundi were negative. The positive findings were tenderness of the skull over the frontal, parietal and occipital regions. The ears showed a perforation of the drum on the right. The heart and lungs were normal. There was marked diffuse abdominal tenderness without masses or spasm. Marked tenderness over the spinous processes in the sacral region.

Temperature, pulse and respiration were normal.

Neurological examination was entirely negative.

Lumbar puncture revealed normal pressure and dynamics.

Cells, 0. Total protein 57 mg. per 100 cc. Gold sol and Wassermann reactions were negative. Red blood cells, 4,360,000; white blood cells, 8,700; polymorphonuclears, 71 per cent. Urinalysis was negative.

Dr. Sosman has kindly consented to discuss the films of the skull which were obtained in this case (Figs. 1 and 2).

DR. SOSMAN: The history is of no help here at all. In fact, the history is that of lower abdominal pain and probably urinary infection. I do not see why they took skull films.

DR. LINGLEY: Roentgen examination of the lumbar spine and pelvis revealed no abnormalities. Although the history did not suggest intracranial disease, the skull examination was

FIG. 2

performed more or less as a matter of routine, because of the headaches, with the expectation that the findings would be negative.

Dr. Sosman: This is the kind of a case I like because there is nothing in the physical examination or history to give one a lead. It is obvious to all of you that there is a dense, calcified mass in the skull which measures about 2×3 cm. From the lateral, anteroposterior, and posteroanterior views it is quite low on the right side, apparently just above the petrous pyramid. That would put it in the posterior portion of the right temporal lobe. The mass is very dense, calcified, structureless and lobulated in outline. If it were a small flat mass, you would consider a calcified hematoma although, in my experience, this condition is quite rare. I do not know of any subdural hematoma that has calcified. A few extradural hemorrhages do have calcium deposit, the type of calcification being flat and sheet-like. If the patient has a purpuric tendency, hemorrhages in the brain substance may calcify. Such hemorrhages occasionally occur in children after whooping cough. In those cases you get small, discrete areas of calcification, usually multiple, which may be ring-like and look almost like gallstones. From the appearance of the calcium in this case, I would rule out hemorrhage.

Infection is rarely, if ever, followed by calcification, probably because infection in the brain is usually fatal. One infection, however, that does calcify is tuberculosis. Tuberculoma, occurring usually in childhood, may contain calcium. The deposits resemble the calcified glands so often found in the mesentery and are quite unlike the calcification shown here.

From the appearance of the calcification in this case, we may safely exclude hematoma and infection, leaving the tumor group as the only other possibility. The tumors in the brain most frequently showing calcification are the gliomas and the meningiomas. About 12 per cent of the gliomas contain enough calcification to be visible in the roentgenogram, but the calcification usually occurs in faint, scattered areas and is rarely as solid and dense as we have here.

Meningiomas occasionally calcify completely, appearing as a solid mass. There is one thing in this film that makes me suspect meningioma and that is the slight concavity at the base of the mass. Most of the mass is rounded, but in the anteroposterior view it is spread out almost like a fan with its concave base on the dura covering the petrous ridge. Meningiomas arise from the dura, usually where it is attached to the bone.

The general signs of tumor are entirely lacking in this case. There are no signs of increased pressure, the sella is perfectly normal and there is no decalcification or increased vascularity. The absence of these signs would indicate that this calcified mass is probably all the tumor there is. The absence of symptoms is confirmatory evidence. A tumor which grows very slowly is apt to produce few or no symptoms, whereas a rapidly developing tumor is apt to give marked symptoms.

I should summarize this case by saying that we have a calcified tumor in the posterior portion of the right temporal lobe with a slight concavity at the base. It is close to the dura, if not arising from the dura, and I judge it to be a calcified meningioma. I think that in any case, whatever it is, it probably has little, if anything, to do with the patient's symptoms, and that this is more or less an incidental finding.

Dr. Schatzki: I was wondering why you did not mention the linear area of calcification just above the large shadow.

Dr. Sosman: I was interested in the little projecting spicule of calcification, about the size and shape of a stub of pencil, which points upward and backward from the main mass. I thought at first that it might be in the tentorium. However, although it is fairly near, it is a little too high to be in the tentorium. Meningiomas do arise at times from the tentorium. Occasionally meningiomas are lobulated. They may be dumb-bell shaped or there may be two apparently separate meningiomas.

Dr. Hampton: That is the densest area of calcification I have ever seen in the skull.

Dr. Schatzki: You believe, do you not, that the tumor could still arise from the ridge in spite of the fact that the calcification is separated from the petrous ridge by about 2 mm. in the anteroposterior view?

Dr. Sosman: Yes, it is quite possible that the tumor arises from the ridge. You may have a transparent zone, a clear space, between the bone and tumor if the tumor arises from the dura. If it arises from the tentorium, there would be quite a space.

DR. LINGLEY: At operation, a temporal bone flap was turned down. The dura and underlying temporal lobe appeared perfectly normal. A needle introduced into the brain substance, however, encountered a solid mass and the brain was therefore incised at this point. A solid mass of calcium was found lying in the temporal horn of the lateral ventricle. It was thought at first that the mass was lying free in the ventricle, but when the mass was picked up with forceps a long pedicle was demonstrated which extended far up the lateral horn toward the body of the ventricle. A second smaller mass of calcium was found attached to the larger mass and both were removed. The patient made a satisfactory postoperative recovery.

Clinical diagnosis: Calcified meningioma.

Dr. Sosman's diagnosis: Calcified meningioma.

Pathological diagnosis: Calcified tumor of the right choroid plexus ?meningioma.

DR. CASTLEMAN: The specimen consisted of two stony hard calcareous masses measuring approximately 3 and 1 cm. in diameter with a small fibrous band connecting them, assuming a sort of dumb-bell shape. There were a few soft areas, 1 to 2 mm. in diameter, on the surface of the larger mass. The tumor lay in the right ventricle attached to or in the choroid plexus. Microscopically there were round calcareous granules that certainly look like psammoma bodies, which can be present in a meningioma or in a normal choroid plexus. Our leaning is towards calcification of the choroid plexus rather than a meningioma, although the latter certainly cannot be ruled out. Dr. Kubik, our neuropathologist, does not recall ever having seen a meningioma so densely calcified.

DR. SOSMAN: I think that explains the spicule of calcification that you see extending backwards from the posterior edge of the tumor. That stem apparently is the choroid plexus extending downward in the temporal horn. I feel that the diagnosis of calcification in the choroid plexus is inadequate because the choroid plexus is never as large as that. The question is whether it is a tumor of the choroid plexus or disease of some kind which enlarged the plexus and later caused its calcification. We have one case of calcified meningioma in the choroid plexus and strangely enough that was also in the temporal horn. The two most probable tumors are ependymoma and meningioma, and it is very difficult to say what the original tumor was when it is as densely calcified as this one is. I would stick to the diagnosis of meningioma.

DR. CASTLEMAN: We have had one autopsied case where we found a similar asymptomatic lesion in the choroid plexus without any evidence of tumor.

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# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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*Advisory Committee on Roentgen-ray and Radium Protection:* W. E. Chamberlain, Chairman, Philadelphia, Pa., G. C. Wilkins, Manchester, N. H., L. A. Campbell, Saginaw, Mich.

*Janeway Lecture Committee:* Curtis F. Burnam, Chairman, Baltimore, Md.

*Committee on Arrangements:* Edwin C. Ernst, Chairman, St. Louis, Mo., L. R. Sante, St. Louis, Mo., A. N. Arneson, St. Louis, Mo.

*Representatives on The American Board of Radiology:* Henry Schmitz, Chicago, Ill., Rollin H. Stevens, Detroit, Mich., B. P. Widmann, Philadelphia, Pa.

*Twenty-fourth Annual Meeting:* St. Louis, Mo., 1939.

# EDITORIALS

## ELLIS FISCHEL
## 1883–1938

A TRAGIC automobile accident on the morning of May 14, 1938, was responsible for the untimely death of our member and colleague of the American Radium Society, Dr. Ellis Fischel. He was duty bound in the interest of a cancer prob-

lem as Chairman of the Missouri State Cancer Commission when this unfortunate accident occurred.

Ellis Fischel was born in St. Louis on July 3, 1883, and received his preliminary and medical education in this city. In 1908 he received his medical degree from the Washington University School of Medicine, while he obtained his A.B. degree at Harvard University in 1904. He completed a two years' internship at the St. Louis City Hospital, after which he took postgraduate work in European universities in the study of pathology, radium therapy and the allied branches of medicine and surgery.

After his return to St. Louis Dr. Fischel began his practical career in surgery and very early became active as a consultant and member of the staff of most of the larger hospitals. He served as a member of the faculty of both the St. Louis University and Washington University Schools of Medicine throughout his energetic career; nevertheless, his greater interests were centered in the clinical and scientific research problems of the Barnard Free Skin and Cancer Hospital. Undoubtedly, the fact that his father had served as president of this cancer institute stimulated Dr. Fischel's interest in the early diagnosis and treatment of malignant new growths, as developed by this organized free hospital.

At the time of his tragic death he was Secretary of the Executive Medical Board, elected member of the Board of Directors, and director of the Department of Surgery of the Barnard Free Skin and Cancer Hospital. Dr. Fischel was active in both the local and national medical, surgical, and radiological organizations. As Chairman of the Missouri State Committee of the Society for the Control of Cancer and the Missouri Plan for Cancer Control, he proved to be an indefatigable worker in the interest of a state cancer hospital for the indigent.

Our sincere and heartfelt sympathy is extended to the members of his family in this great bereavement, realizing with them the untimely and irreparable loss to the community of this professional colleague, benefactor, administrator of public affairs and social servant of humanity.

Edwin C. Ernst

## WHAT IS THE ISSUE?

FOR A number of years there has existed a controversy, which occasionally and in certain communities has flared into warlike proportions, between organized hospitals and the organized medical profession concerning the practice of medicine in hospitals. Particular interest has centered around the specialties of radiology, pathology, anesthesiology, physical therapy, and others which are closely identified with the treatment of patients during hospitalized illness.

During recent years the question has been brought to a head by the advent of hospital insurance and by the determination on the part of some hospital administrators, met by decreasing endowment income, to augment hospital income from fees paid for medical services performed in the hospital. To make hospital insurance more saleable they have demanded that certain medical services be included in the benefits offered by the hospital. To secure needed revenue they have employed specialists on a salary or commission basis, sufficiently low to permit, in some cases, a net income to the hospital after all expenses are paid.

Organized medicine has steadfastly insisted that the quality of medical care and the future progress of medicine will suffer if private practice is supplanted by institutionalized practice, delivered, sold, and controlled by a third party corporation, hospital or otherwise. Medical practice,

says the profession, is the function of doctors and the physician's relation to his patients must not be complicated by a corporate distributing agency. Hospitals, they say, are institutions where doctors may treat the sick, retaining the same professional relationship with the patient that they have in the home or private office.

The American Hospital Association, representing the organized hospital world, has, with a good deal of emphasis, expressed an opposite view. The hospital, they say, is more than a place where doctors treat their patients. It is an institution which provides not only facilities but medical service. In this day of corporate structure and mass production, the hospitals say their function includes the provision of salary or commission contracts.

With diametrically opposed "principles" promulgated by first one side and then the other, and with prejudiced opinion presented as fact, it seems desirable that an attempt be made to clearly define the issues.

The medical profession recognizes that improvements in hospital facilities and administration have been partly responsible for the tremendous strides of medical science and the high quality of medical care enjoyed by the American people today. Hospital administrators are no less generous in their praise of the physician for his humanitarian contributions to the public welfare.

The differences arise in the field of economics. The medical profession demands that the hospital meet its financial obligations with revenues from its endowments, its income from charities, its profits on the rental of its rooms and facilities and the sale of its *hospital* services. It denies the hospital's right to earn a profit from the sale of physicians' services.

The American Hospital Association insists that the hospital has a right to provide certain medical services, along with its hospital facilities. Says the Board of Trustees of the American Hospital Association, "Provision of medical services in hospitals is part of the responsibility of the hospital." W. P. Slover, a hospital superintendent, writing in the journal of the American Hospital Association, advises hospitals to increase their revenue by educating the public to "more regular use of the laboratory, the x-ray and diagnostic services for systematic check-ups on their health."[1] It seems apparent that this may place the hospital corporation in competition with private physicians. Editorially the same journal declares that, "Diagnosis, treatment, and care of the ambulatory sick become increasingly the function of the hospital, as the hospital develops into the centre of community health activities."[2]

It is generally recognized that corporations, being artificial legal entities, cannot be licensed and are therefore not permitted to practice medicine. Among hospitals there is a widespread belief that incorporated hospitals do not fall under this category. Says their official journal, "The laws regulating the practice of medicine by corporations do not apply and were never intended to apply to hospitals."[3] No authority for the statement is cited. The Board of Trustees of the American Hospital Association[4] is slightly contradictory when it attempts to justify corporate practice by declaring that it is not corporate practice. "The performance of diagnostic and therapeutic procedures by staff members constitutes the practice of medicine *in* hospitals. It is not the practice of medicine *by* hospitals," they say. Presumably this would be true even if such practice *in* the hospital resulted in an appreciable profit to the hospital corporation. The Board further states that, "The financial arrangement between a hospital and a physician is not a determining factor in the ethics or legality of medical practice."

The hospitals further contend that even if laws prohibiting corporate practice of medicine should apply to hospitals and if it be admitted that hospitals are actually

[1] *Hospitals*, June, 1938, *12*, 50.
[2] *Hospitals*, May, 1937, *11*, 73.
[3] *Hospitals*, June, 1938, *12*, 65.
[4] In a statement adopted June 18, 1938.

practicing medicine when they hire physicians, it is still correct to define radiology, pathology and certain other specialties as hospital services instead of medical services. Apparently the hospitals are not too sure of their ground, else they would not find it necessary to provide three premises for the same syllogism. Hospitals which practice medicine for a profit do not practice medicine; anyway laws prohibiting corporate practice do not apply to hospitals; and if these both be untrue, the services under question are not medical services but are hospital services.

"At what point can a line be drawn, if anywhere, between 'hospital' service and 'medical' service?" asks Michael Davis, a member of the Council of the American Hospital Association,[5] implying that the one is the other. As a matter of fact the question is not so difficult as it might appear. The terms are properly used—one is "hospital" and one is "medical." Numerous court decisions have defined the terms and according to Bouvier's Law Dictionary, "The primary meaning of the terms medical attendance or medical services is the rendering of professional medical services."[6] The Supreme Judicial Court of Massachusetts has held that, " . . . While the term 'medical services,' if used without limitation, may be susceptible of a broad construction, the statutes cited clearly indicate that those words, as therein used, are restricted to medical assistance rendered by the physician or under his direction and control."[7]

Physicians have delegated certain medical functions to be performed by nurses, interns, and other employees of the hospital under their direction, but these functions are performed by the hospital corporation through the sufferance and under the authority of physicians. It does not confer upon hospitals the right to indulge in the practice of medicine by themselves in disregard of the preference of physicians.

It is likewise true that the courts are well agreed that corporations cannot practice medicine and that this applies to hospital corporations. In Granger v. Adson[8] the Minnesota Supreme Court reasoned that inasmuch as a corporation or a layman could not practice law by employing a licensed attorney, for the profit of the corporation or layman employing him, to act as attorney or counsel for others, it was improper and contrary to statute and public policy for a corporation or layman to practice medicine in a similar way. Similar decisions have been rendered by courts in many other states.

When the editors of the journal of the American Hospital Association make the statement that, "The laws regulating the practice of medicine by corporations do not apply and were never intended to apply to hospitals,"[9] they are on unsound grounds. This and a number of other statements emanating from hospital headquarters are rather convincingly refuted in a recent opinion by Judge J. F. Bouchelle of West Virginia.[10] After citing considerable authority to support his opinion that a hospital corporation could not practice medicine, the Court concluded by saying, "In order that there be no misunderstanding as to the scope of this opinion, attention is directed to the fact that it is not intended to preclude contracts by individuals or corporations to furnish *hospital facilities* only. . . . Neither is it intended to prevent medical attention gratuitously contributed by doctors and surgeons to patients of incorporated charitable organizations."

For reasons of brevity it is impossible to quote the many court decisions or the statutory law bearing upon all the points raised in recent official statements by organized hospitals. It is sufficient to say that there is ample authority to disprove many of their contentions, granting at the same time that the courts are by no means completely agreed on some points.

[5] *Modern Hosp.*, July, 1938, p. 57.
[6] Baldwin's Century Edition, p. 795.
[7] People v. Pierson, 176 N. Y. 201.
[8] Granger v. Adson, et al. Minn. 250 N. W. 722.
[9] *Op. cit.*
[10] Amick v. Staats Hospital, in the Circuit Court of Kanawhat County, W. Va.

By a rather vitriolic exception to certain principles adopted at the San Francisco session of the American Medical Association, organized hospitals have clearly defined the issue. Organized medicine wants the practice of medicine to be left to private physicians—organized hospitals demand that hospitals be privileged to take over certain specialties to be sold at a profit by the corporation. Especially are they insistent that in hospital insurance plans they be allowed to include certain medical services as benefits along with their hospital services. Medicine denies them this right, on the grounds that it alters the professional status of the physician and is contrary to public policy.

The Philadelphia County Medical Society went to court to enjoin local hospitals from proceeding with such a plan against the expressed desires of the profession. After several days of testimony before the Master, the attorneys for the hospitals agreed to accede to the demands of the county society and the plan was changed to separate hospital and medical services. Doctors who testified made it clear that they objected, not to insurance which paid cash benefits for medical services, but to the inclusion of these services as benefits in kind to be offered as a part of hospitalization.

Radiologists, pathologists, anesthetists, and others whose specialties are most coveted by the hospitals, hold to the same philosophy and ethical principles as does all organized medicine. While it is undeniably true that contractual relations between practitioners of these specialties and their hospitals have placed many of these physicians in the position of employees of the hospital corporation, the fact remains that theirs is a medical service and not a hospital service. Radiologists, for instance, have permitted hospitals to collect their fees, receiving in reimbursement a salary or commission, for the simple reason that it offered an accounting convenience. Never have they relinquished their professional rights as physicians and never had they agreed that they were performing a hospital service instead of a medical service.

Regardless of the fiscal arrangement under which a radiologist practices his profession in the hospital, he denies the hospital a right to profit from his practice or to sell his services on an annual premium basis to groups of insurance subscribers. The hospital is entitled to retain a portion of radiologic fees sufficient to repay it for its costs in maintaining a department where patients can be treated and where the doctor may treat them, but it has no moral, legal, or ethical right to demand a net profit from professional services rendered by members of the staff in the hospital.

The issue is clear. It should be discussed dispassionately, and attempts at settlement should always be made in a spirit of friendly cooperation. Physicians and hospitals must work together; neither can get along without the other. That the difficulties here discussed can be settled to the mutual advantage of physician and hospital and to the advantage of the public has been repeatedly proven by experience in many localities throughout the nation.

# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this section solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES*

### United States of America

**American Roentgen Ray Society**
*Secretary*, Dr. C. B. Peirce, Royal Victoria Hospital, Montreal, Canada. Annual Meeting: Haddon Hall, Atlantic City, N.J., Sept. 20–23, 1938.

**American College of Radiology**
*Secretary*, Dr. E. L. Jenkinson, 1439 S. Michigan Ave., Chicago, Ill. Annual meeting, 1939: To be announced.

**Section on Radiology, American Medical Association**
*Secretary*, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: St. Louis, Mo., 1939.

**Radiological Society of North America**
*Secretary*, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting: Pittsburgh, Pa., Nov. 27–Dec. 2, 1938.

**Radiological Section, Baltimore City Medical Society**
*Secretary*, Dr. Howard H. Ashbury, Baltimore. Meets third Tuesday each month, September to May.

**Radiological Section, Connecticut Medical Society**
*Secretary*, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets twice annually in May and September. Special meetings may be called by the Chairman.

**Radiological Section, Los Angeles Co. Med. Soc.**
*Secretary*, Dr. M. L. Pindell, 678 S. Ferris Ave., Los Angeles, Calif. Meets on second Wednesday of each month at County Society Building.

**Radiological Section, Southern Medical Association**
*Secretary*, Dr. Roy G. Giles, Temple, Texas.

**Brooklyn Roentgen Ray Society**
*Secretary*, Dr. E. Mendelson, 120 E. 19th St., Brooklyn, N. Y. Meets monthly on first Tuesday, October to April.

**Buffalo Radiological Society**
*Secretary-Treasurer*, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months, place of meeting selected by the host.

**Chicago Roentgen Society**
*Secretary*, Dr. R. G. Willy, 1138 N. Leavitt. Meets second Thursday of each month October to May inclusive at the Palmer House.

**Cincinnati Radiological Society**
*Secretary*, Dr. J. E. McCarthy, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

**Cleveland Radiological Society**
*Secretary*, Dr. Harry Hauser, 3395 Scranton Rd. Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

**Denver Radiological Club**
*Secretary*, Dr. E. A. Schmidt, 4200 E. 9th Ave., Denver, Colo. Meets third Tuesday of each month.

**Detroit Roentgen Ray and Radium Society**
*Secretary*, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

**Florida State Radiological Society**
*Secretary*, Dr. J. H. Lucinian, 403 Huntington Bldg., Miami, Florida. Meetings held twice a year, May and November.

**Georgia Radiological Society**
*Secretary*, Dr. R. C. Pendergrass, Prather Clinic Bldg., Americus, Ga. Meets twice annually: in November and at annual meeting of Medical Association of Georgia in the spring.

**Illinois Radiological Society**
*Secretary*, Dr. E. P. Halley, Decatur and Macon County Hospital, Decatur, Ill. Meetings held quarterly, time and place designated by president.

**Indiana Roentgen Society**
*Secretary*, Dr. C. C. Taylor, 23 E. Ohio St., Indianapolis, Ind. Meeting held the second Sunday in May annually.

**Long Island Radiological Society**
*Secretary*, Dr. S. G. Schenck, 115 Eastern Parkway, Brooklyn, N. Y. Meets at Kings County Med. Soc. Bldg. on fourth Thursday, each month, October to May, 8:30 P.M.

**Michigan Association of Roentgenologists**
*Secretary*, Dr. C. S. Davenport, St. Lawrence Hospital, Lansing. Three meetings a year, Fall, Winter, Spring.

**Milwaukee Roentgen Ray Society**
*Secretary*, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis. Meets monthly. Place of meeting named by the president.

**Minnesota Radiological Society**
*Secretary*, Dr. H. M. Weber, Mayo Clinic, Rochester, Minn.

**Nebraska Radiological Society**
*Secretary*, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Nebr. Meets first Wednesday of each month, at 6 P.M., at either Omaha or Lincoln.

**New England Roentgen Ray Society**
*Secretary*, Dr. E. C. Vogt, 300 Longwood Ave., Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

**Radiological Society of New Jersey**
*Secretary*, Dr. W. J. Marquis, 198 Clinton Ave, Newark, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

**New York Roentgen Society**
*Secretary*, Dr. R. D. Duckworth, 170 Maple Ave., White Plains, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

**North Carolina Roentgen Ray Society**
*Secretary*, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

**Central New York Roentgen Ray Society**
*Secretary*, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year—January, May, November.

**Pacific Roentgen Club**
*Secretary*, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

**Pennsylvania Radiological Society**
*Secretary*, Dr. L. E. Wurster, 416 Pine St., Williamsport, Pa. Annual meeting, May, 1939. Exact time and place to be decided.

**Philadelphia Roentgen Ray Society**
*Secretary*, Dr. B. R. Young, Temple University Hospital. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St

**Pittsburgh Roentgen Society**
*Secretary*, Dr. H. W. Jacox, 4800 Friendship Ave., Meetings held second Wednesday each month, 4:30 P.M., October to June at various hospitals.

**Rochester Roentgen Ray Society, Rochester, N. Y.**
*Secretary*, Dr. S. C. Davidson, 277 Alexander St., Meets on second Thursday from October to May, inclusive, 8 P.M., Rochester Academy of Medicine Building.

**St. Louis Society of Radiologists**
*Secretary*, Dr. W. K. Mueller, University Club Bldg. Meets fourth Wednesday of October, January, March and May, at a place designated by the president.

**San Francisco Radiological Society**
*Secretary*, Dr. L. H. Garland, 450 Sutter St., San Fran-

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

cisco. Meets monthly on first Monday at 7:45 P.M., alternately at Toland Hall and Lane Hall.

SOUTH CAROLINA X-RAY SOCIETY
*Secretary*, Dr. R. B. Taft, 105 Rutledge Ave., Charleston. Meets at time and place of South Carolina Medical Assn.

TENNESSEE RADIOLOGICAL SOCIETY
*Secretary*, Dr. F. B. Bogart, 311 Medical Arts Bldg. Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

TEXAS RADIOLOGICAL SOCIETY
*Secretary*, Dr. G. D. Carlson, 3121 Bryan St., Dallas, Texas. Next regular meeting in San Antonio, Oct. 22, 1938.

UNIVERSITY OF MICHIGAN DEPARTMENT OF ROENTGENOLOGY STAFF MEETING
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
*Secretary*, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

VIRGINIA RADIOLOGICAL SOCIETY
*Secretary*, Dr. V. W. Archer, University Hospital, University, Va. Meets annually in October.

### CUBA

SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA
*Secretary*, Dr. Francisco Padron, Enrique, Villuendas 64, Havana, Cuba. Meets monthly in Havana.

### BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1, or as advertised.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8:15 P.M. at the Royal Society of Medicine, 1, Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
*Secretary*, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
*Secretary*, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to Nov. incl. for scientific discussion.

CANADIAN ASSOCIATION OF RADIOLOGISTS
*Secretary*, Dr. A. C. Singleton, Medical Arts Bldg., Toronto, 5, Ontario.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
*Secretary*, Dr. C. M. Jones, Inglis St., Ext., Halifax, N.S.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
*Secretary*, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

### CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
*Secretary*, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
*Secretary*, Dr. J. Martin-Crespo, Fuencarral, 7, Madrid, Spain. Meets monthly in Madrid.

SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
*Secretary* for French language, Dr. A. Grosjean, La Chaux de Fonds.
*Secretary* for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during month of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
*Secretary*, Dr. Walter Altschul, German University, Prague, 11.52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
*Permanent Secretary*, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SÜD- UND WESTDEUTSCHE RÖNTGENSELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
*Secretary*, M. Ponzio, University of Turin, Prof. Turin

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
*Secretary*, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
*Secretaries*, Drs. S. A. Reinberg and S. G. Simonson, Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
*Secretaries*, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
*Secretaries*, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
*Secretary*, Dr. Jan Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
*Secretary*, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY IN SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
*Secretary*, Dr. G. Biering, Copenhagen.
Meets the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA ROENTGEN SOCIETY
Meets first Wednesday of each month, at 6:30 P.M. at Zentral-Röntgen Institut des allgemeinen Krankenhauses Alserstrasse 4.

### ORIENT

JAPAN X-RAY ASSOCIATION
c/o Orthopedic Surgery, Tokyo Imperial University. Meets annually in April.

KINKI ROENTGEN-ABEND SOCIETY
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto Japan. Meets bi-monthly on third Sunday.

# BOOK REVIEWS

*Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.*

X-Rays and Radium in the Treatment of Diseases of the Skin. By George M. MacKee, M.D., Professor of Clinical Dermatology and Director of Department of Dermatology (Skin and Cancer Unit) New York Post-Graduate Medical School and Hospital, Columbia University; Consulting Dermatologist, St. Luke's Hospital, etc. Third edition, thoroughly revised. Cloth. Price, $10.00. Pp. 830, with 308 illustrations Philadelphia: Lea & Febiger, 1938.

The third edition of this book has been thoroughly revised. New chapters have been added, others enlarged and some deleted consequent upon information gained since the publication of the second edition in 1927.

Every conceivable phase of the subject has been treated in a thorough manner and the author has used as collaborators such authorities as Edith H. Quimby, Harold Bouton, Anthony C. Cipollaro, Franklin H. Grauer, George M. Lewis, Henry D. Niles, Fred Wise, Arthur U. Desjardins and Hamilton Montgomery.

In controversial matters the various phases are presented in an unbiased manner.

There is one criticism and one suggestion that might be offered. The author, in the chapter on "Primary Prickle Cell (Squamous cell) Epithelioma," does not wholeheartedly endorse radiant energy as the therapeutic method of election. This view is not in accord with a great many and he so states. His apparent reaction is probably due to the fact that many of these lesions require higher voltage and higher filtration to effect a cure than is employed in dermatological practice.

In this chapter "The Medico-Legal Relations of Roentgen Therapy and Radium Therapy" greater space could be advantageously devoted to more accurate means of avoiding suits rather than defending them. An enumeration of the most common errors of physicians as encountered by lawyers, such as incomplete records, etc., and the precautions necessary to avoid them would be of inestimable value.

These are minor criticisms, however, and in no way detract from the value of the book. It remains as the standard book of its kind, done in the thorough manner characteristic of its author, and is invaluable as a text and reference. It can be recommended, without reservation, as an important addition to the library of the radiologist, the dermatologist, the general practitioner, and the student.

Edgar M. McPeak

Primary Carcinoma of the Lung. By Edwin J. Simons, M.D., Member of the Staff, St. Gabriel's Hospital, Little Falls, Minn.; Member of the Staff, Lymanhurst Health Center, Minneapolis, Minn., etc. Cloth. Price, $5.00. Pp. 263, with 30 illustrations, and two colored plates. Chicago: The Year Book Publishers, Inc., 1937.

An increasing interest in the general subject of cancer has given rise to a keener sense of observation on the part of the physician. Such heightened powers of observation have immeasurably increased the number of cases of cancer diagnosed. With the general increase has come also an increase in the incidence of carcinoma in certain organs, its occurrence in which thirty years ago was thought to be rare. Noticeable among these is carcinoma of the lung.

To many, carcinoma of the lung is still a rarity, despite the fact that it is now known to comprise from 5 to 12 per cent of carcinomas in general. The incidence of bronchogenic carcinoma is said to have increased, and with the increase have come numerous publications on the subject. Some of these works have had great value, others have been, as is much of the mushroom literature which springs up suddenly about any new subject, absolutely worthless.

It is this unfortunate propensity of physicians to write on any subject, whether or not their contribution carries merit, which makes Simons' review of the existing literature on primary carcinoma of the lung so valuable.

The author has taken a vast and rapidly accumulating literature and condensed it. He has culled the good from the bad, and has brought forth a fine review. Such books, when well done

as this one is, are of great help, for they enable busy physicians to learn in a relatively short time the current correct views concerning a certain subject.

In a day when there is much talk of the passing of the general practitioner, it is refreshing to know that there still live men in medicine who, despite the lack of the cloistered protection of some great university, are still creative, and still believe that to give to medicine is better than to take from medicine. It is a lesson in resourcefulness.

The book is well printed and bound. The illustrations are excellent.

This is a fine book, well worth the careful attention of the internist, the specialist, and the general practitioner, for all of whom it was written.

William M. Tuttle

The Roentgenologist in Court. By Samuel Wright Donaldson, A.B., M.D., F.A.C.R. St. Joseph's Mercy Hospital, Ann Arbor. Cloth. Price, $4.00. Pp. 230. Springfield, Illinois: Charles C. Thomas. 1937.

It is probable that physicians of no other group are required to appear in court as often as the radiologist. There are also business complexities connected with the practice of radiology which make some knowledge of the law particularly desirable for the radiologist. For these and other reasons, Donaldson's book is particularly timely, and your reviewer has had occasion to refer to it with satisfaction on several occasions during the few weeks it has been on his desk.

Naturally the subject matter of the book does not lend itself readily to a critical digest. It is well arranged, clearly and concisely presented and adequately indexed. Pertinent citations of court decisions are a valuable feature which should have an appeal to the legal as well as to the medical profession.

The book is of handy size and well printed. It is by no means an arduous task to read it. Inasmuch as it is believed to be the only book on the subject in the field, it should be a "must" book for all radiologists.

Thomas A. Groover

Traité de chirurgie orthopédique. Par L. Ombrédanne et P. Mathieu, Editors. Tome I–V. Cloth. Price, $75.00. Pp. 4,479, with 3,033 illustrations. Paris: Masson et Cie, 1937.

There can be no question as to the need for a comprehensive work on orthopedic surgery in the roentgenologist's library. If he is to assume and maintain his place as a consultant to general practitioners as well as other specialists he must be informed as to general procedures in orthopedic surgery and abreast of latest developments. If no reliable source of information is at hand he will fail in compliance for daily requests for opinions as to prognosis and treatment or possibly misguide his questioners.

This five-volume treatise is therefore received with much interest. One need not read in detail its nearly five thousand pages to appreciate the completeness, accuracy and up-to-dateness of the subject matter. While the work is in the French language and the author-collaborators are all professors, surgeons and executives in French schools and hospitals, the material is not merely a summation of French methods and French ideas but is rather a compilation of the accepted ideas and procedures of orthopedists the world over, arranged and evaluated by French scientists. To radiologists the fact that Ledoux-Lebard is one of the collaborators will instantly recommend the work as of high standard.

Although the list of authors includes sixty-six surgeons, anatomists, pathologists, and internists, a striking characteristic of this treatise is the unity so frequently lacking in this type of literature. This must be due in no small measure to the careful direction and editing of Ombrédanne and Mathieu. An example of the methodic completeness of treatment may be seen in Mathieu's own discussion of pseudarthroses. A brief introduction with definitions is followed by the pathologic anatomy listing five classes of false joints with their essential features, next by discussions of four mechanical causes and two trophic causes, next by pathogenesis and then by clinical study. Under treatment, possibilities of closed and open methods are considered, the latter under five headings; then follow many pages of technical discussion of surgical procedures including various forms of grafts. In conclusion, the author discusses various indications for operation, considering the question of function and possibilities for its improvement. These thirty pages on a special subject are quite typical of the

method of treatment of the various subjects by different authors. Throughout there is as much conciseness as is consistent with thoroughness.

The authors have used the term orthopedics in its broadest sense and the table contents of the five volumes bears this out. They admit the weakness of the term as not being inclusive of surgery of adults or of much traumatic surgery but also point out the limitations of such terms as "bone and joint surgery" or "surgery of the locomotive system," and decide that the term generally used is understood to include the subject of acute trauma, bone tumors, neuromuscular and trophic disturbances as well as the problem of correction or prevention of deformities of children. A very complete table of contents is found in the first volume and an index for the five volumes is found in Volume V so that the books are really one unit separately bound for convenience in handling. The bindings are attractive, the paper and printing of good quality and illustrations profuse and clear.

To those who read French this treatise will bring much useful information, provide many interesting hours, and will give their possessor a pride of ownership.

E. Walter Hall

Traumatismes du pied et rayons X: Malléoles—astragale—calcanéum—avant-pied. Par Étienne Destot, Lyon. Second edition. Foreword by Dr. Alexis Carrel. Paper. Price, 45 fr. Pp. 292, with 152 illustrations. Paris: Masson et Cie, 1937.

The first edition of Destot's treatise on injuries of the foot and ankle, with special emphasis on the roentgen examination, appeared in 1911. He had hoped to complete a second edition, but the World War interfered and his sudden death in 1918 prevented the completion of the work. The present volume is a second edition, revised and prepared for publication by two of his former pupils, E. Gallois and P. Japot.

The foreword by Dr. Alexis Carrel is followed by a preface by the two collaborators in which they state that while the text conforms for the most part with the original edition, the results of Destot's studies and observations during the war have been added. Succeeding this, is Destot's own introduction, and thereafter six chapters are devoted to the physiology and anatomy of the foot and ankle. The surgical anatomy of each bone is discussed in detail with relation to fractures and dislocations.

The remaining portion of the book is divided into three parts, the first deals with fractures and dislocations of the ankle joint, the malleolar region only being included; the second describes types and treatment of injuries of the posterior half of the arch of the foot, the posterior tarsal bones; the third, which is brief but concise, is devoted to lesions of the anterior half of the arch, the anterior tarsal, the metatarsal bones and phalanges.

Destot's classification of fractures of the ankle is based on physiologic and not on mechanical principles. He points out that the main function of the tibia is that of support. The fibula acts merely as a splint along the outer side of the ankle joint to maintain the direction of the foot. His classification consists of two main groups: (1) those fractures which involve only the mortise of the ankle joint and disturb the equilibrium of the foot, the fibular type of fracture, and (2) those which involve the "pilon tibial" (the tibial "pestle") or the tibial type of fracture. The second type thus involves the support of the body. He states that the objective of every surgeon should be to insure the equilibrium of the leg on the foot. In reduction of a fracture or dislocation the foot should be fixed in such position that the points of normal pressure are re-established and maintained. Ashhurst has called attention to the rather severe criticisms of this classification by Quénu who thought the gravity of the lesions depended entirely on whether they are isolated, involving one bone only, or associated, involving both tibia and fibula. The classification of Destot is also not acceptable to those who believe that the classification of fractures of a given region should be based on the mechanism of production rather than on a purely physiologic basis.

Throughout the entire work, emphasis is placed on roentgen examination and interpretation. Errors of interpretation and technique are discussed. Old fractures as well as recent, with resultant deformities, are described in detail. In these, close examination of the roentgenogram may determine the type of surgical procedure and treatment.

The function of each bone in the support of the arch of the foot is considered and in that portion devoted to the posterior half of the arch full attention is paid to fractures of the astragalus, so often overlooked in surgical textbooks because of the more frequent fractures

of the calcaneum. Fractures of the astragalus are divided into associated (those combined with fractures of the tibial "pestle" or of the calcaneum or scaphoid), and isolated. Included in the latter group, in some cases, there may be a coincident dislocation of the astragalus. In addition, there is an anatomical classification, fractures of the body and of the neck. In the case of the calcaneum, fractures are divided upon a mechanical basis into the avulsion type of Boyer and the crush type of Malgaigne. Destot further divides them into posterior fractures (those situated posterior to the articular surface of the astragalus), fractures of the median portion and of the anterior portion.

Whether or not one is in agreement with the classification of ankle fractures of Destot, the book cannot fail to be of help both to the surgeon and the roentgenologist in the study and treatment of fractures and dislocations of this region. Many of the lesions described are difficult to treat and the emphasis placed upon the restoration of normal function based on physiologic principles makes the volume especially valuable.

R. S. Bromer

Atomic Artillery: Modern Alchemy for Everyman. By John Kellock Robertson, f.r.s.c., Professor of Physics, Queen's University, Kingston, Canada. Cloth. Price, $2.25. Pp. 177, with 26 illustrations. New York: D. Van Nostrand Company, Inc., 1937.

Our conceptions of the physical nature of the thing we call matter are determined in the first instance by the gross evidence conveyed by our senses, and it comes as a shock to learn that many a solid material contains at least as much "empty" space as it does substance. This is the most elementary of the series of paradoxes that is encountered as one delves more deeply into the mysteries concerning the constitution of matter.

The chemist, when he had reached the limit of his ability to subdivide compounds, signalized his achievement with brave finality by naming his ultimate, indivisible particles: atoms. We know now that atoms have their own structure and can be broken down or built up.

The story of these newer developments is told in nontechnical language by Professor Robertson in "Atomic Artillery." It tells something about the guns used, the propellants and the projectiles: electrons, positive rays, photons, cosmic rays and the rest of them. It recounts briefly the results achieved and the fundamental problems involved. It conveys enlightenment with a minimum of confusion and is altogether an admirable elementary summary of modern alchemy and its methods.

Barnett Cohen

## BOOKS RECEIVED

A Text-Book of X-Ray Diagnosis. By British Authors. In Three Volumes. Edited by S. Cochrane Shanks, M.D., Physician, with Charge of Out-Patients, Departments of Radiology and Electro-therapy, Charing Cross Hospital; Radiologist, The Prince of Wales' General Hospital, etc.; Peter Kerley, M.D., M.R.C.P., D.M.R E., Physician to the X-Ray Department, Westminster Hospital; Radiologist, Royal Chest Hospital, etc., and E. W. Twining, M.R.C.S., L.R.C.P., D.M.R.E., Radiologist, Royal Infirmary, Manchester; Radiologist, Christie Hospital, etc. Volume I: Cloth. Price, 50s. Pp. 591, with 398 illustrations. Volume II: Cloth. Price, £2.2.0. Pp. 458, with 307 illustrations. London: H. K. Lewis & Co., Ltd., 1938.

Textbook of Diagnostic Roentgenology. By Lewis J. Friedman, M.D., Director, Roentgen-Ray Department, Bellevue Hospital; Instructor in Radiology, New York University College of Medicine; Chief Radiologist, Stuyvesant Polyclinic, etc. Cloth. Price, $10.00. Pp. 623, with 638 illustrations. New York: D. Appleton-Century Company, Inc., 1937.

Tuberculosis among Children and Young Adults. By J. Arthur Myers, Ph.D., M.D., F.A.C.P., Chief of Medical Staff and Director of Tuberculosis Activities, Lymanhurst Health Center, Professor of Preventive Medicine, University of Minnesota. Cloth. Price, $4.50. Pp. 401, with 71 illustrations. Springfield, Illinois: Charles C. Thomas, 1938.

The Radiology of Pulmonary Tuberculosis. By J. E. Bannen, M.B., Ch.B., D.M.R.E., Hon. Radiologist: Hull Royal Infirmary: Radiologist: Hull Corporation Hospitals and Tuberculosis Clinics, East

Riding County Council and Raywell Sanatorium, Hull Corporation Mental Hospital, Willerby, Hull and Sculcoates Dispensary. Cloth. Price, $4.50. Pp. 156, with 39 illustrations. Baltimore: William Wood & Co., 1937.

Synopsis of Digestive Diseases. By John L. Kantor, Ph.D., M.D., Associate in Medicine, Columbia University; Gastroenterologist and Associate Roentgenologist, Montefiore Hospital for Chronic Diseases, New York. Cloth. Price, $3.50. Pp. 302, with 40 illustrations. St. Louis: C. V. Mosby Co., 1937.

L'exploration radiologique post-opératoire de la voie biliaire principale. Par B. Desplas, P. Moulonguet et P. Malgras. Paper. Price, 40 fr. Pp. 120, with 40 illustrations. Paris: Masson et Cie, 1938.

The Rheumatic Diseases. A Course of Lectures Arranged by The Medical Staff of the St. John Clinic and Institute of Physical Medicine. Edited by Sir Leonard Hill, M.B., LL.D., F.R.S., Director of Research, St. John Clinic and Institute of Physical Medicine and Consultant to the Rheumatic Unit at St. Stephen's Hospital (London County Council), and Philip Ellman, M.D., M.R.C.P., Physician to St. John Clinic and Institute of Physical Medicine and Consultant Physician to the Rheumatic Unit at St. Stephen's Hospital (London County Council). With a Foreword by Sir Arthur MacNalty, K.C.B., M.D., F.R.C.P., Chief Medical Officer to the Ministry of Health. Cloth. Price, $4.00. Pp. 270, with 46 illustrations. Baltimore: William Wood & Co., 1938.

Introduction to Ophthalmology. By Peter C. Kronfeld, M.D., Professor of Ophthalmology, Peiping Union Medical College. Cloth. Price, $3.50. Pp. 331, with 32 illustrations. Springfield, Illinois: Charles C. Thomas, 1938.

Disability Evaluation: Principles of Treatment of Compensable Injuries. By Earl D. McBride, B.S., M.D., F.A.C.S., Assistant Professor in Orthopedic Surgery, University of Oklahoma School of Medicine; Attending Orthopedic Surgeon to St. Anthony's Hospital; Associate Orthopedic Surgeon to Wesley Hospital, etc. Second edition revised. Cloth. Price, $8.00. Pp. 623, with 374 illustrations. Philadelphia: J. B. Lippincott Co., 1938.

Traité de chirurgie orthopédique. Par L. Ombrédanne et P. Mathieu, editors. Tome I–V. Cloth. Price, $75.00. Pp. 4,479, with 3,033 illustrations. Paris: Masson et Cie, 1937.

Clinical Roentgen Therapy. Edited by Ernst A. Pohle, M.D., Ph.D., F.A.C.R., Professor of Radiology, Chairman, Department of Radiology and Physical Therapy in the University of Wisconsin, Madison, Wisconsin. Foreword by George W. Holmes, M.D., Roentgenologist to the Massachusetts General Hospital and Clinical Professor of Roentgenology in Harvard Medical School, Boston, Mass. Cloth. Price, $10.00. Pp. 819, with 199 illustrations. Philadelphia: Lea & Febiger, 1938.

Le traitement radiologique de l'actinomycose. Par Axel Renander. (Acta radiol., Suppl. XXXV.) Communication de Radiumhemmet et de l'institut Roentgen de l'Hopital Serafimer, Stockholm. Chefs: MM. G. Forssell et E. Berven, professeurs. Paper. Price, Swed. cr. 8.00. Pp. 75. Stockholm: P. A. Norstedt & Söner, 1937.

The Construction of Vulcanite Applicators for Applying Radium to Lesions of the Buccal Cavity, Lips, Orbit and Antrum. By Desmond Greer Walker, M.A., M. Dent. Sc., M.B., B.Ch., Assistant Dental Surgeon to the Royal Dental Hospital; Dental Registrar at the Middlesex Hospital; Chief Assistant to the Plastic Department, St. Bartholomew's Hospital. Foreword by W. Warwick James, O.B.E., F.R.C.S., L.D.S. Cloth. Price, 5/–. Pp. 61, with 23 plates. London: John Murray, 1938.

I quadri radiologici delle invaginazioni del tubo digerente. By Dott. Bruno Bonomini. Paper. Pp. 114, with 82 illustrations. Belluno: Casa Editrice Libraria A. Salvador, 1937.

Curieterapia in dermatologia. By Prof. Vincenzo Palumbo, Direttore Istituto Radioterapico Italiano. Paper. Price, L. 30. Pp.

87, with 76 illustrations. Belluno: Casa Editrice Libraria A. Salvador, 1937.

Il radium nella cura dei tumori maligni delle prime vie aero-digestive. By Prof. C. Torrigiani, Direttore servizi di otolaringoiatria, RR. Ospedali Riunti, Firenze, and Prof. V. Palumbo, Direttore Istituto Radioterapico Italiano, Firenze. Paper. Pp. 134, with 68 illustrations. Belluno: Casa Editrice Libraria A. Salvador, 1937.

Ergebnisse der biophysikalischen Forschung in Einzeldarstellungen. Herausgegeben von Professor Dr. B. Rajewsky, Direktor des Kaiser-Wilhelm-Instituts für Biophysik in Frankfurt am Main. Band I. Ultrakurzwellen in ihren medizinisch-biologischen Anwendungen. Von H. Dänzer, H. E. Hollmann, B. Rajewsky, H. Schaefer und E. Schliephake. Paper, price RM. 19., bound, RM. 21. Pp. 308, with 188 illustrations and 24 tables. Leipzig: Georg Thieme, 1938.

Some Quantitative Aspects of the Biological Action of X and τ Rays. By C. M. Scott. Medical Research Council, Special Report Series, No. 223. Paper. Price, 1s. 6d. Pp. 99, with 21 illustrations. London: His Majesty's Stationery Office, 1937.

Medical Uses of Radium: Summary of Reports from Research Centres for 1936. Medical Research Council, Special Report Series, No. 226. Paper. Price, 1s. 0d. Pp. 41, with 6 illustrations. London: His Majesty's Stationery Office, 1937.

Physical Aspects of Radium and Radon Therapy. Department of Health, Commonwealth of Australia. Paper. Pp. 60, with 14 illustrations. Canberra: L. F. Johnston, Commonwealth Government Printer, 1936.

A Quantitative Rontgen-Biological Method with the Back Hairs of Guinea Pigs as Experimental Objects. By Børge Worning, Finseninstitut, Röntgenabteilung, Copenhagen. Translated from Danish by W. E. Calvert. Paper. Pp. 102, with 38 illustrations. Copenhagen: Det Hoffensbergske Etablissement, 1937.

A Symposium on Cancer. Addresses by Leiv Kreyberg; Clarence C. Little; Madge T. Macklin; Edgar Allen; Howard B. Andervont; James Ewing; Gioacchino Failla; Henri Coutard; Warren H. Lewis; Stanley P. Reimann; James B. Murphy, and Emil Novak. Given at an Institute on Cancer conducted by the Medical School of the University of Wisconsin, September 7–9, 1936. Cloth. Price, $3.00. Pp. 202, with several illustrations. Madison: University of Wisconsin Press, 1938.

Some Fundamental Aspects of the Cancer Problem. Symposium Sponsored by the Section on Medical Sciences of the American Association for the Advancement of Science, Atlantic City, N. J., December 29, 1936–January 1, 1937. Edited by Henry Baldwin Ward. Occasional Publications of the American Association for the Advancement of Science. No. 4. June, 1937. Suppl. to Science, Vol. 85. Cloth. Price, $2.50; paper, price, $2.00. Pp. 248, with illustrations. New York: The Science Press, 1937.

Standards for the Diagnosis and Treatment of Cancer. By The Executive Cancer Committee of the Iowa State Medical Society. Paper. Pp. 168. Iowa City, Iowa: Athens Press, 1937.

The Life of Chevalier Jackson: An Autobiography. Cloth. Price, $3.50. Pp. 229, with many plates. New York: The Macmillan Company, 1938.

The Origin and Properties of the Human Aura. By Oscar Bagnall, Ba., Cantab. Cloth. Price, $2.00. Pp. 197, with illustrations: New York: E. P. Dutton & Co., 1938.

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# DEPARTMENT OF TECHNIQUE

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# COMPRESSION BLOCKS IN GASTROINTESTINAL ROENTGENOGRAPHY

## A SIMPLIFIED TECHNIQUE FOR ROENTGENOGRAPHING MUCOSAL PATTERNS

*By* MORRIS A. HERSHENSON, B.S., M.D.
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PHYSICIANS especially interested in diseases of the digestive tract are favorably impressed by the additional information received from "compression roentgenograms" in a gastrointestinal series. These often reveal a central lesion which previously had been obscured when the hollow organ was fully distended with the radiopaque mixture. In this communication is described a simple device which permits making compression pictures of the mucosal relief of any accessible portion of the digestive tube. It is efficient, simple, and quite inexpensive.

Compression roentgenograms are obtained by approximating the anterior and the posterior walls of the stomach or duodenum, or of any accessible portion of the digestive tract, by pressure applied to the anterior abdominal wall. This maneuver removes the greater bulk of the opaque contrast material previously introduced into the viscus, so that the barium mixture is pushed off the mucosal crests and remains only in the intervening troughs, thus revealing the pattern of the mucosal lining.

Although not difficult to make, nevertheless such compression roentgenograms are not being produced during gastrointestinal roentgen examinations as often as they are really indicated. The reason for this is the prevailing idea that some specially designed roentgen apparatus is needed. The expense of such new equipment is naturally a factor in delaying the universal adoption of aimed compression technique. The application of the device described here necessitates no such alteration in the standard roentgen technique usually employed in roentgenology of the gastrointestinal tract, and hence its application should contribute an additional tool useful in the search for organic pathology.

The compression device consists of four wooden blocks of varying thicknesses, each 4 inches square. They are ½ inch, ¾ inch, 1 inch, and 1½ inches thick. Each block is encircled by a steel band or a heavy copper wire, so as to render its margins radiopaque. Thereby, the block can be located on the fluoroscopic screen, and the limits of the compressed area become clearly defined on the roentgenogram. The top edges of each block are rounded off for the comfort of the patient who will lie upon it. When in use, the block is inserted in a loosely fitting flannel bag to afford a hold for removing it without disturbing the patient's position.

The roentgenograms of the stomach, cap, or intestines are most frequently made with the patient in the horizontal position, lying on his abdomen. The region to be photographed is selected and centered under direct roentgenoscopic control. Then one of the compression blocks is inserted under the patient's abdomen, as he lies prone upon the roentgen table. The block's opaque margins facilitate its accurate

Fig. 1. The compression blocks are made of wood, 4 inches square and varying in thickness from ½ to 1½ inches. Each block is encircled by a stout steel wire, so as to render its margins radiopaque.

placing under the region which one wants to study. The patient's weight produces the compression. Of course, the thicker the block used, the deeper it presses into the abdomen and the greater is the pressure exerted on the barium-filled organ. Experience has shown, however, that a block thicker than 1½ inches, rather than appreciably increasing the extent of compression, only serves to raise the patient away from the roentgen table. The ¾ inch block is the one most frequently used in making compression roentgenograms of the stomach and the duodenal cap. The 1½ inch block is ordinarily employed over the terminal ileum, cecum, and other selected regions of the colon. The block of optimum thickness, however, is best decided upon by direct screen observation of its effect upon the barium-filled organ.

Fig. 2. The selected compression block is placed in a loosely fitting flannel bag, so as to afford a hold for its manipulation beneath the patient.

With the block thus properly placed and well centered, the loaded cassette is inserted into the pan of the Potter-Bucky diaphragm, the switch is changed from the roentgenoscopic to the roentgenographic tube overhead, and the film is exposed with the usual roentgenographic setting. The movable Potter-Bucky grid is recommended in order to obtain pictures of the greatest clarity. If, however, one prefers not to use it, or if he does not have a Potter-Bucky diaphragm built into his roentgen table, then a cassette tunnel must first be placed under the patient's abdomen and the film inserted here. Should the vertical position be required, then the tilt-table is raised to about a 60° angle from the horizontal. This allows the viscera to drop downward, yet permits the patient to lean forward upon the block inserted beneath him, and thus allows it to continue pressing into the selected portion of his abdomen.

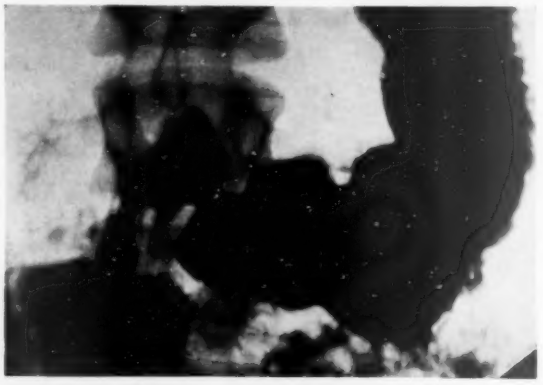

Fig. 3. This patient has an active duodenal ulcer, but the conventional roentgenogram shows only a slight filling defect of the cap. The roentgen evidence here is not absolutely diagnostic of the true lesion.

There is no other change in the roentgenographic technique. There is no need for

rapid change-over from roentgenoscopic to roentgenographic settings. There is no necessity for discarding a well-functioning roentgen apparatus, nor for subjecting it to costly and rather cumbersome alterations.

Numerous compression roentgenograms, made by this procedure, were shown in a scientific exhibit at the 1937 meeting of the American Medical Association. I trust that they were convincing evidence of the satisfactory mucosal relief pictures so easily obtainable by the use of these blocks. The device is recommended for several reasons:

1. It is effective, simple, and quite inexpensive. One can easily make his own set of wooden blocks.

2. It requires no alteration in the standard roentgen equipment, nor any change in the roentgenographic technique to which one may have become accustomed.

3. It permits making compression roentgenograms with the patient lying horizontally on his abdomen, the position usually selected for the routine filming of the stomach, the duodenal cap, and the intestines.

4. A block of the same thickness may be used at repeated follow-up re-examinations, and thereby comparable films can be obtained to show the lesion under exactly the same degree of pressure. This is particularly valuable, for instance, in observing the progressive changes in the size of the crater of a healing peptic ulcer.

Fig. 4. A small compression block, applied over the cap, brings out the barium-filled ulcer crater. This is the pathognomonic roentgen sign of ulcer.

Fig. 5. A thicker block, applied over the same region, expresses nearly all the opaque meal from the duodenum and the distal part of the stomach. But the fleck of barium in the ulcer crater persists.

5. This device does not interfere with the use of the movable Potter-Bucky grid. In fact, it encourages the use of the Potter-Bucky in gastrointestinal roentgenography.

6. On the resulting roentgenogram, it clearly demarcates the area under compression, but in no way obscures the remainder of the picture.

7. It presents nothing to break or leak, as with air-inflated devices.

8. Lastly, though not of least importance, it does not require the operator to stand in front of the patient and the fluoroscopic screen and close to the roentgen tube while it is emitting the roentgenographic dose of rays. Instead, he may retreat to his usual screened and safe position at the controls and so avoid repeated exposure to heavy intensities of roentgen rays.

# INDEX TO ABSTRACTS

## ROENTGEN DIAGNOSIS


*Head*

SAVITSKY, N., and BENDER, M. B.: Tumor of brain with normal encephalogram ..... 456

BRADLEY, C.: Effect of encephalography on blood sugar level of children ..... 456

ALPERS, B. J., and ROWE, S. N.: The astrocytomas ..... 457

ARONS, I.: Ossifying fibroma of maxillary sinus ..... 457

GESCHICKTER, C. F.: Tumors of the jaws ..... 457

*Neck and Chest*

BROMME, W., NELSON, H. P., and FINDLEY, THOMAS, JR.: Case of delayed metastatic sarcoma of pleura ..... 458

LYNCH, K. M., and SMITH, W. A.: Pulmonary asbestosis. III. Carcinoma of lung in asbesto-silicosis ..... 458

SCHENCK, S. G.: Diagnosis of congenital cystic disease of lung ..... 458

MYERS, J. A., DIEHL, BOYNTON, R. E., and TRACH, B.: Development of tuberculosis in adult life ..... 460

MCCLOSKEY, J. A.: Superimposed spontaneous pneumothorax complicating treatment of pulmonary tuberculosis ..... 461

POPE, A. S.: Incidence of tuberculosis in silicotics ..... 461

BRUMFIEL, D. M., and GARDNER, L. U.: Silicotuberculosis ..... 461

KOROL, E.: Cardiogenic theory of pulmonary emphysema ..... 461

KOROL, E.: Emphysema of artificial-pneumothorax lung ..... 462

LESLIE, C. J.: Pulmonary echinococcosis ..... 462

CHARR, R.: Carcinoma of bronchus in association with anthracosilicosis ..... 462

PORTER, R. E., and GORDON, W. H.: Size of heart in pulmonary tuberculosis ..... 462

NEMET, G., and ROSENBLATT, M. B.: Cardiac failure secondary to chronic pulmonary tuberculosis ..... 463

FOX, J. P., and HOSPERS, C. A.: Solid teratoid tumors of anterior mediastinum ..... 463

SCHLOMKA, G., and DAUM, H.: Normal spontaneous variations in size of heart ..... 463

COHEN, J. N., and LEVINE, H. S.: Calcification of myocardium with bone formation ..... 464

CUSHING, E. H.: Diverticulum of pericardium. 464

CUSHING, E. H., and MORITZ, A.: Diverticulum of pericardium; further data showing presence of extrathoracic abscess ..... 465

WALLACE, R. P.: Traction diverticulum of esophagus ..... 465

SCHNEIDER, L., and SEGAL, J.: Bronchography with iodized oil not without danger ..... 465

*Abdomen*

BAYER, L.: Concerning the possibility of a clinical-roentgenological differentiation between benign and malignant ulcers of stomach ..... 466

SCHLOSS, J., ETTINGER, A., and PRATT, J. H.: Diagnosis of diseases of stomach by gastroscopic and x-ray relief studies ..... 466

LIEBER, M. M., STEWART, H., and LUND, H.: Carcinoma of infrapapillary portion of duodenum ..... 467

STEWART, H. L., and LIEBER, M. M.: Carcinoma of suprapapillary portion of duodenum ..... 468

JACKSON, A. S.: Regional enteritis ..... 468

FOX, N. I., WARFIELD, C. H., and LEADER, L. O.: Tuberculous enterocolitis. I. A study of terminal ileum and colon by barium meal and barium enema ..... 469

JACOBI, H. G., and LUST, F. J.: Roentgenographic studies of mucous membrane of colon. III. Mucosal detail studies as aid in early recognition of carcinoma of colon ... 469

FERRIS, H. W.: Calcified lesions of primary tuberculosis in intestine in adults ..... 469

JOHNSON, J., ELLIS, A. L., and RIEGEL, C.: Studies of gall bladder function. XIV. Absorption of sodium tetraiodophenolphthalein from normal and damaged gall bladder ..... 470

*Genitourinary System*

RYTAND, D. A.: Roentgenographic study of orthostatic albuminuria by means of injections of diodrast ..... 470

DONALDSON, S. W., and HOWARD, S. C.: Primary carcinoma of adrenal ..... 471

*Skeletal System*

COLE, J. P.: Dislocation and fracture-dislocation of lower cervical vertebrae ..... 471

AITKEN, A. P., and CHILDRESS, H. M.: Intra-articular displacement of internal epicondyle following dislocation ..... 471

MAGNUSSON, R.: Tuberculous osteitis of ischium ..... 472

FUNSTEN, R. V., KINSER, P., and FRANKEL, C. J.: Dashboard dislocation of hip ..... 472

Benjamin, B., and Miller, P. R.: Hypothyroidism as cause of disease of hip..... 472
Dittrich, R. J.: Osteomyelitis of patella..... 473
Sontag, L. W.: Evidences of disturbed prenatal and neonatal growth in bones of infants aged one month..... 473
Gillespie, J. B., and Siegling, J. A.: Melorheostosis Léri..... 474
Blumenthal, S., and Lesser, A.: Acute phosphorus poisoning..... 474
Sanderson, G. H., and Smyth, F. S.: Chondrodysplasia (Ollier's disease)..... 474
Freeman, J.: Morquio's disease..... 475
Caffey, J.: Lead poisoning associated with active rickets..... 475
Wallgren, A.: Rheumatic erythema nodosum. 476
Portis, R. B.: Pathology of chronic arthritis of children (Still's disease)..... 476
Ghormley, J. W.: Ossification of tendo achillis. 476
McMaster, P. E.: Influence of venous stasis on production of chronic arthritis..... 477
Connor, C. L.: Clinically demonstrable bone changes in leukemia..... 477
Voss, H.: Parosteal and para-articular bone formation in organic nervous diseases..... 477
Burch, G. E., and Sodeman, W. A.: Hereditary hypoplasia of mesenchyme..... 478
Hills, R. G., and McLanahan, S.: Brittle bones and blue scleras in five generations. 478
Albright, F., Sulkowitch, H. W., and Bloomberg, E.: Further experience in diagnosis of hyperparathyroidism..... 479

*Blood and Lymph System*

Yater, W. M.: Maintenance of functional integrity of occluded large arteries as demonstrated by thorotrast arteriography.... 480

*General*

Godfrey, M. J.: Hydatid disease..... 480
Smereker, H.: Study of radiointensity in close proximity to radioactive preparations by means of thin-walled ionization chamber. 481
Haschè, E.: A radiation shield enabling an exact measurement of radiation..... 482
Nitzge, K.: High tension protection without technical limitations..... 482
Reinhard, M. C., and Candee, C. F.: Observations on the use of a lead diaphragm to collimate an x-ray beam for treatment purposes..... 482
Taft, R. B.: The radioactivity of thorium dioxide sol..... 482
Rosenthal, M.: Experimental radium poisoning. II. Changes in the teeth of rabbits produced by oral administration of radium sulphate..... 482
Zirkle, R. E., Aebersold, P. C., and Dempster, E. R.: Relative biological effectiveness of fast neutrons and x-rays upon different organisms..... 483
Mottram, J. C.: Production of epithelial tumors by irradiation of a precancerous skin lesion..... 483
Butterworth, J. S.: Observations on the histogenesis of ovarian tumors produced in mice by x-rays..... 484
Cathie, I. A. B., and Davson, J.: Microincineration of epithelial tumours with regard to radiosensitivity..... 484
Stone, Robert S.: Skin reactions caused by 1,000 kilovolt and 200 kilovolt radiations. 484

# ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

## ROENTGEN DIAGNOSIS

### HEAD

SAVITSKY, NATHAN, and BENDER, MORRIS B. Tumor of the brain with normal encephalogram. *Am. J. M. Sc.*, July, 1937, *194*, 96–103.

Intracranial lesions might be expected to show evidence of expansion. They might produce an obliteration of subarachnoid air channels or alterations in the size, shape or position of the ventricles. In a series of 120 cases of definite brain tumor, in whom intracranial air injections had been made and analyzed by the neurologist, the neurosurgeon and the roentgenologist, 7 cases were considered to have normal aerograms. In addition, the authors have included 2 other cases, likewise considered to have normal aerograms, these having been studied in other hospitals.

The first case cited was found to have a spongioblastoma multiforme, measuring about 3 cm. in diameter, located in the left paracentral lobule. The second case was found to have an unclassified "sarcoma," infiltrating the basal ganglia and floor of the third ventricle. The third case presented normal studies until shortly before his death when a shift of the ventricular system was noted; autopsy revealed a glioma, the size of an orange, in the right paracentral lobule. The fourth case was of a cavernous angioma, measuring about 3 cm. in diameter, located in the region of the left angular gyrus. The fifth case was studied at intervals and found to have an intracranial calcification, which appeared to increase in size; a calcified glioma was removed from the right parietal lobe. Two studies were made of the sixth case; the first appeared normal; the second made only one month later showed the ventricular system displaced to the right; craniotomy revealed a glioma in the left parietal lobe. Case 7 was found to have a hemangio-endothelioma in the region of the left corpus striatum, hippocampus and island of Reil. Case 8 had three encephalograms, the third revealing a density in the right subfrontal region and a shift of the ventricular system to the left; a hemangiomatous tumor involving two-thirds of the right pre-frontal lobe was excised. Case 9 was found to have a glioma in the right paracentral lobule.

In all of these cases the clinical signs were sufficient for localization and diagnosis of tumor. Four of them showed papilledema even when the ventricular system appeared normal. Two showed calcifications in the presence of "normal encephalograms." Aerograms are most important and minor variations must not necessarily be considered indicative of pathology for there are wide variations of normal.—*A. A. de Lorimier.*

BRADLEY, CHARLES. Effect of encephalography on blood sugar level of children. *Am. J. M. Sc.*, Feb., 1937, *193*, 259–263.

In 1849, Claude Bernard showed that the central nervous system may influence carbohydrate metabolism. It has been shown that alterations of intracranial pressure as produced by cranial trauma may affect glucose tolerance and blood sugar levels. Mader reported a brief rise in blood sugar after encephalography. Boeter reported similar changes and Schönfeld reported a temporary rise after ordinary diagnostic lumbar punctures in children. The author studied 15 children who were subjected to encephalography. None of these showed endocrine or metabolic disorders and no abnormalities were noted in the spinal fluids. The multiple syringe method was employed; the spinal fluid was drained as completely as possible and it was replaced by an equal or greater volume of air. Various anesthetics were used: avertin, phenobarbitol, sodium amytal, paraldehyde, morphine and atropin and ether. Fasting specimens of venous blood were taken before withdrawing the spinal fluid (twelve to seventeen hours after the previous meal), and again shortly after completing the roentgenography. All cases showed an increase in the blood sugar levels after the procedure. The encephalograms were essentially negative; 3 of the cases showed "cortical atrophy" and 2 "unilateral cerebral atrophy." There appeared to be no relationship as to sex, age, clinical diagnosis or anesthetic. Five of the cases were more carefully studied, they having blood sugar determinations at shorter intervals during the withdrawal of the spinal fluid and during the injection of the air. The hyperglycemia was found to appear im-

mediately during the fluid replacement and it reached a peak thirty to sixty minutes after starting this procedure. It was not possible to measure accurately any changes of intraspinal pressure. Roentgenography did not seem to be a factor, since changes were noted before starting it and moreover, Boeter studied blood sugar values before and after routine skull films and noted no change.—*A. A. de Lorimier.*

Alpers, Bernard J., and Rowe, Stuart N. The astrocytomas. *Am. J. Cancer*, May, 1937, *30*, 1–18.

In an analysis of 128 cases of astrocytoma, the authors proposed to analyze the following questions: namely, what are the different types of astrocytomas from a histological point of view and is there any correlation between the histological features and the clinical characteristics?

They propose the following classification:

I. Fibrillary
  (a) Solid
    (1) Piloid
    (2) Diffuse
  (b) Cystic
II. Giant-cell
III. Cellular

In the group of fibrillary astrocytomas, as a whole, the diffuse solid astrocytomas compose 82 per cent of their tumors.

The tumors are slow growing both clinically and histologically. In the various subgroups, however, there is no corrrelation between the histological and clinical features. The cystic astrocytomas which, although classified under fibrillary are definitely separate, occur chiefly in young individuals, produce a history of symptoms of one year or more, cause definite neurological signs and respond very favorably to surgical treatment. The giant-cell type grows slowly and is usually located subcortically in the cerebrum. These findings are in agreement with the histological picture. The cellular astrocytomas grow rapidly and produce a high degree of intercranial pressure, increase, and respond very poorly to surgical attack. Again the clinical and histological characteristics are in good agreement.

The histology of the various types is described at length and is well illustrated with 12 photomicrographs. There is no mention of the use of roentgen rays either in treatment or diagnosis.—*J. S. Weber.*

Arons, Isidore. Ossifying fibroma of the maxillary sinus: report of a case successfully treated with irradiation. *Am. J. Cancer*, March, 1937, *29*, 551–555.

A white boy, aged eleven, originally diagnosed small spindle cell osteosarcoma of the antrum received intensive irradiation, both roentgen and radium, and two series of Coley's toxin. A review of the tissue changed the diagnosis to ossifying benign fibroma. The author feels that the irradiation was too severe in view of the corrected diagnosis but presents the case as one effectively treated by irradiation. The boy is living and well ten years without recurrence.—*J. S. Weber.*

Geschickter, Charles F. Tumors of the jaws. *Am. J. Cancer*, May, 1935, *24*, 90–126.

Three hundred and twenty-three cases of tumors of the jaw from the Surgical Pathological Laboratory of Johns Hopkins Hospital are classified and their pertinent characteristics recorded. There are three broad classifications: (1) dental and benign osseous tumors, (2) malignant osseous tumors, (3) epithelial tumors.

Under the first classification, radicular or dental root cysts are the most common in young adults. The roentgenogram shows a central area of rarefaction with well-defined margins extending about the apex of the tooth.

Follicular or dentigerous cysts usually occur in young individuals and are usually found in the region of the third molar. In the roentgenogram, it is shown as a monolocular cyst containing an unerupted tooth which is pushed away from the gum by the growth of the cyst about the crown.

Adamantine epitheliomas are considered potentially malignant homologues of follicular cysts. The tumors occur most frequently in young adults and are most often found in the molar region of the lower jaw. Roentgenologically, it is a monocystic or polycystic tumor of sharp outline, but differentiation by roentgenogram is by no means absolute. The treatment of choice of all three lesions is surgical, and recurrences are few except in the adamantinoma. This latter is relatively radioresistant, so that roentgen rays and radium have a very small part in the treatment of these conditions.

The odontonomas are mixed tumors. In the roentgenogram, an irregular dense calcified mass is usually seen imbedded in a rarefied area or adjoining an unerupted tooth. The soft type

tumors tend to recur but the hard type, which is most frequent, is distinctly benign.

Epulides most usually arise from without the bone and the angiomatous type is most prevalent in pregnancy. External irradiation is a successful form of treatment, although simple excision and cauterization frequently suffices.

Central giant-cell tumors of the jaw are most frequently found in the young adult, and more frequently at the symphysis or angle of the jaw, where they tend to grow and destroy bone rapidly. In the roentgenogram, a central trabeculated area of absorption expands a thin shell of bone and in the younger patients, unerupted teeth in the vicinity may lead to an erroneous diagnosis of dentigerous cyst. It is only in the region of the sphenoid or temporal fossa that these tumors tend to recur, for curettage suffices in most other locations.

Benign ossifying tumors of the jaw, consisting of ossifying fibromas, are more cellular and are found in the young, and osteomas which are more differentiated, are found in older adults. In the ossifying fibromas, the tumor mass in the roentgenogram is of regular contour and less dense than normal bone. In those of large size, there is subperiosteal ossification which gives a distinct outline to the margin but in no case is there a peripheral irregularity in the form of periosteal spicules forming at right angles. The ossifying fibromas of this series have not metastasized and those treated surgically have yielded better results than those treated by irradiation.

Osteomas are usually symptomless, bony swellings, and in the roentgenogram a small dome-like swelling of increased density and clearly defined margins is seen. Treatment is optional and always surgical when necessary.

The second group, sarcomas of the jaw, contains three types. The osteogenic sarcoma grows rapidly and even though the 10 cases reported were treated radically, only 2 survived two years. In the roentgenogram, there are irregular dense foci of new bone production alternating with areas of bone destruction and at the margins there is an occasional spicule formation at right angles.

Chondrosarcomas grow more slowly and in the roentgenogram produce an area of osteoporosis which extends rapidly to either margin of the mandible. Erosion without expansion is the rule and the tumor is accompanied by pain. All 7 cases of this group were fatal regardless of treatment, 1 sixteen years after her first operation.

Ewing's sarcoma of the jaw is usually found in children or young adults and the symptoms of pain and swelling are usually under one month's duration. Irregular areas of bone destruction are the most common feature but the roentgenogram is not characteristic. Although radiosensitive, no cure is recorded by means of irradiation alone. Excision with irradiation is the treatment of choice.

Malignant epithelial tumors of the jaw are always secondary.—*J. S. Weber.*

### NECK AND CHEST

BROMME, WILLIAM, NELSON, H. P., and FINDLEY, THOMAS, JR. A case of delayed metastatic sarcoma of the pleura, illustrating the diagnostic value of artificial pneumothorax. *Am. J. Cancer*, June, 1935, *24*, 334–339.

*Authors' summary*. "1. A death from osteosarcoma, metastatic to the pleura 13 years after the appearance of the primary lesion is reported and microscopic sections from both sites are presented.

"2. Artificial pneumothorax is a valuable adjunct in the study of pleural effusions of doubtful etiology. It should be carried to the point where complete visualization of the pleural surfaces is possible."—*J. S. Weber.*

LYNCH, KENNETH M., and SMITH, W. ATMAR. Pulmonary asbestosis. III. Carcinoma of lung in asbesto-silicosis. *Am. J. Cancer*, May, 1935, *24*, 56–64.

A carcinoma of the lung was found at microscopic examination, after having been missed both by roentgen examination and at the gross autopsy examination. There was a long-standing fibrosis from asbestosis and silicosis and numerous pulmonary complications obscured the diagnosis.—*J. S. Weber.*

SCHENCK, SAMUEL GEORGE. Diagnosis of congenital cystic disease of the lung. *Arch. Int. Med.*, July, 1937, *60*, 1–21.

Until recently, congenital cystic disease of the lung has been a diagnosis made at autopsy; it has been described under such terms as fetal bronchiectasis, congenital bronchiectasis, atelectatic bronchiectasis or congenital pulmonary lymphangiectasis, etc. Bartholinus recorded the first case in 1687. Koontz, in 1925, collected reports of 108 proved cases. The author, adding 4

cases in 1936 and 5 more since then, has collected additional reports to bring the total up to 381.

These cysts may be single or multiple. At birth they contain fluid. This fluid content may persist or the cyst may rupture and drain the contents into a bronchus. If there is free communication during both inspiration and expiration, the cyst will remain stationary and non-expansile. However, if a valve-like action is produced at the drainage orifice of the cyst, so that air enters it and becomes trapped, the cyst "balloons" out or becomes expansile. These characteristics may apply to single, multiple or trabeculated cysts.

Multiple cysts were reported in 233 of the cases. The right lung alone was involved in 42 per cent of these; the left, in 37 per cent and bilateral involvement was noted in 21 per cent. Other congenital anomalies were found in 45 of the cases.

Among infants and children the more important clinical symptoms include dyspnea and cyanosis, with or without cough; possibly expectoration and fever (if there be secondary infection); possibly hemoptysis. There may be pains in the chest, weakness, anorexia, palpitation and even vomiting. Either tuberculosis or asthma may be suspected. A careful physical examination may be helpful but a diagnosis is more likely with the aid of roentgenography. Fluid cysts must be distinguished from solid tumors (teratoma, chondroma, ganglioneuroma), acquired cystic disease (dermoid, hydatid and mediastinal cysts) and inflammatory lesions (pneumonia, encapsulated empyema, pulmonary abcess, etc.). A non-expansile air cyst is to be differentiated from an emphysematous bulla (the former having a moderately thin capsule which may enclose a few fine linear strands), cavitations of tuberculosis (which have much more dense walls), etc. An expansile cyst may be confused with a partial pneumothorax. Multiple air cysts may simulate acquired bronchiectasis in appearance. The injection of iodinized oil or bronchoscopic examinations may be of value in the diagnosis. The expansile type of cyst is of course the most serious and in such cases drastic surgery such as lobectomy may be indicated.

The first of the cases reported by the author, at this time, was of a two-month-old infant who had developed dyspnea after a "cold," when given nasal drops. The child "looked like a thymus baby." Roentgenography revealed multiple large and small cysts in the right thorax with extreme deviation of the heart and mediastinum to the opposite side. Aspiration of air was performed, with some relief, but the child died within twenty-four hours.

The second case was of a shoemaker, aged forty-five, who had had a slight cough for two years. He had been told that he had tuberculosis but his sputum had repeatedly been negative and he had had no sweats, fever nor weakness. In the posteroanterior projection of the chest there appeared to be a pneumothorax at both bases. The cystic walls were more clearly visualized in the lateral projections. This case was studied at intervals for over six years and no changes could be noted in the cysts.

Another case was of woman, aged forty-seven, complaining of a cough (non-productive) and dyspnea of three years' duration. Roentgenography revealed an ovoid area of opacity in the superior aspect of the right hilar region; its density was homogeneous and its borders sharp. Bronchoscopy showed evidence of extrinsic pressure on the trachea and right main bronchus. Roentgen therapy was given but it produced no effect on the symptoms nor on the size or appearance of the opacity. This patient was carefully studied for more than a year.

The fourth case was of a baker, aged twenty-nine, complaining of a cough, some hemoptysis and pain in his chest for two years. He had not had fever nor night sweats. He felt strong and had gained about 40 pounds during these two years. Roentgenography revealed a small annular density in the left mid-thoracic field; there was no evidence of perifocal infiltration; the apices were clear and elsewhere there were no features of tuberculosis. Iodinized oil did not enter the cavity. Repeated sputum analyses were negative for tubercle bacilli and the roentgenographic findings were unchanged for more than a year during which the patient was studied.

The fifth case was of a woman, aged fifty-eight, who complained of a cough and loss of 70 pounds in weight during the past year. Weakness and dyspnea had been progressive. There were no night sweats nor afternoon fever. Roentgenography revealed a lattice-work appearance with small annular shadows in the lower half of each pulmonary field. Bronchography revealed diffuse bilateral bronchiectasis

of the saccular or cystic variety.—*A. A. de Lorimier.*

MYERS, J. ARTHUR, DIEHL, H. S., BOYNTON, RUTH E. and TRACH, BENEDICT. Development of tuberculosis in adult life. *Arch. Int. Med.*, Jan., 1937, *59*, 1–31.

Remotely, in the days of Hippocrates, tuberculosis was recognized in the stages of "phthisis" or "consumption." Later, it was realized that actual infection might be had for some time before these stages, but there has been a general tendency to withhold a diagnosis until clinical manifestations are present or until there are roentgen or laboratory findings. During the first stages of tuberculous infection there may be no such evidence. In reaction to invasion by the tubercle bacillus the neutrophile is the first victim; it phagocytizes the bacillus but it is overcome by the polysaccharide content of the organism. The monocyte then engulfs the bacterium and perhaps part of the neutrophile and due to the phosphatid content of the bacillus it is converted into an epithelial cell. The bacillus may then be overcome or it may multiply and cause the development of a tubercle which attracts a wall of lymphocytes. Peripheral fibrosis and actual bone formation may then take place, but the tubercle bacilli are likely to remain viable and they may later become free for extension of activity. There may be no means of recognizing these preliminary stages of infection. After a period of three to seven weeks, however, sufficient tuberculo-protein can be expected to have been liberated to produce sensitization in the tissues and thereafter positive reaction to skin testing can be considered specific proof of there being at least the first infection type of tuberculosis somewhere in the body. In some parts of the country, about 90 to 95 per cent of young adults show this reaction, whereas in other parts, only 5 to 10 per cent react positively. The authors found only about 10 per cent positive reactions among student nurses during their period of probation and, since they and medical students have unusual contact with tuberculous patients, they decided to observe changes in the combined group, making routine tuberculin tests during their years of study.

This report concerns 85 subjects who have been grouped on the basis of the tuberculin reaction, the type of lesion which subsequently developed and other factors. Group 1 included only 2 cases. These had had a negative reaction to tuberculin; later, a positive reaction, and developed erythema nodosum. Group 2 included 21 cases. In these, the tuberculin reaction changed from negative to positive and a primary focus was demonstrated roentgenographically. In some of these the roentgenological evidence was noted as long as a year after the positive reaction to tuberculin. In such, the lesions could not definitely be considered the first infection type. There seemed to be no criteria to distinguish this first infection lesion. Most ideal studies in infants revealed only 25 per cent recognition of primary foci among those reacting positively to the tuberculin tests. It seemed likely that primary lesions were microscopical or almost so, in many instances. Group 3 included 18 cases in whom the reaction to tuberculin changed from negative to positive with or without roentgenographic visualization of parenchymal lesions but in all of whom there developed pleural effusions. These cases seemed to signify reinfection. Many of these showed no residual evidence of the involvement after absorption of the fluid or release of it, though others showed various evidences of pleural thickenings and impairment of diaphragmatic function. Group 4, consisting of 25 cases, included those in whom the reaction to tuberculin changed from negative to positive with later clinical manifestations of pulmonary tuberculosis. Some of these showed primary foci and some had pleurisy with effusion. In the majority of these cases sufficient time elapsed between the finding of a positive reaction to tuberculin and the conditions mentioned to believe that these findings are significant of reinfection. Group 5 included 15 cases who reacted positively to the first testing with tuberculin, though no evidence of the disease could be demonstrated. Later, reinfection forms of tuberculosis made their appearance. One of these had pleurisy with effusion; one had renal tuberculosis and the others had pulmonary lesions. However, the intensity and response to treatment by these cases did not differ from those who did not show positive sensitivity when first studied but who later developed positive reactions and subsequently, reinfections. Group 6 included 4 cases who had not had preliminary tuberculin tests but who developed extensive tuberculous lesions. These cases are included to refute the expression that "during the teen age period roentgenograms of the chest will reveal evi-

dence of any disease which may cause illness at a later time in life." All of these patients, aged twenty-two, twenty-nine, nineteen, and twenty-three, had had roentgenograms which had been considered negative, yet several years later each case showed an advanced pulmonary tuberculosis.

Neither meningitis nor miliary disease occurred among any of the patients of this series —probably because care was instituted early, on the basis of findings picked up by the periodic examinations.—*A. A. de Lorimier.*

McCloskey, James A. Superimposed spontaneous pneumothorax complicating the treatment of pulmonary tuberculosis. *Am. Rev. Tuberc.*, June, 1937, *35*, 805–814.

Superimposed spontaneous pneumothorax is often a most serious and also the most common acute complication of artificial pneumothorax therapy in pulmonary tuberculosis. The condition has several contributing and direct causes which, by the exercise of diligent care, can be reduced to a minimum, but some cases are unavoidable. There are several complications of superimposed spontaneous pneumothorax, the most important being empyema, surgical emphysema, patent bronchopleural fistula, mediastinal displacement, mediastinal hernia of the lung, and congestive heart failure.

In a series of 1,131 cases of induced pneumothorax with 52,835 refills, secondary spontaneous pneumothorax occurred 161 times, an incidence of 14.2 per cent. In this series there were 26 deaths, a mortality rate of 16.1 per cent. The mortality rate of superimposed spontaneous pneumothorax in relation to the total number of induced pneumothoraces was 2.3 per cent.—*L. H. Osmond.*

Pope, Alton S. The incidence of tuberculosis in silicotics. *Am. Rev. Tuberc.*, May, 1937, *35*, 638–639.

An examination of data published by Ornstein and Ulmar indicates that the death rate among stone-cutters is slightly over ten times the mortality rate from tuberculosis in the corresponding age and sex group in the same communities for that period. When only the silicotics are considered, the tuberculosis mortality was approximately 40 times greater than the expected mortality.

Eight cases, which were diagnosed by Sampson, Gardner and Pancoast as silicosis and tuberculosis, have been proved correct.—*L. H. Osmond.*

Brumfiel, D. M., and Gardner, L. U. Silico-tuberculosis. *Am. Rev. Tuberc.*, Dec., 1937, *36*, 757–762.

The term, silico-tuberculosis, as used in America to describe a peculiarly chronic manifestation of tuberculosis that occurs only in silicotic lungs, is known in South Africa as tuberculo-silicotic.

Silico-tuberculosis presents certain consistent features which serve to set it apart from common or uncomplicated tuberculosis and from the non-tuberculous pulmonary diseases as well. (1) It appears in the later decades of life, usually the fifth and sixth. (2) It has a strong tendency toward chronicity and a low grade of toxicity. (3) Tubercle bacilli are difficult or impossible to demonstrate until late in the course of the disease.

The histological picture offers an explanation in that the lesions appear to be a mixture of reactions to both tubercle bacilli and to silica in the same area, although sometimes they begin about imperfectly healed tuberculous lesions. On the basis of this and the clinical course, it would seem that there existed in some cases a definite symbiotic relationship. In some this is so complete that the disease remains occult until death ensues from some other cause.

In contrast to these cases of silico-tuberculosis is the picture of individuals in whom ordinary tuberculosis develops on a background of silicosis without the "symbiotic" or "pseudo-symbiotic" stage and steps of evolution. These fall into two clinical groups, the first, which behave as do other cases of ordinary uncomplicated tuberculosis, with the possible exception that in some instances the coincidental silicosis seems to accelerate the progress. The second group consists of those spectacular, but rare, examples of acute tuberculosis with coexisting silicosis. The latter are usually first manifested by a zone of inflammatory reaction about each silicotic nodule and then progress like exogenous primary infections, with rapid extension and uncontrollable progression.—*L. H. Osmond.*

Korol, Ephraim. The cardiogenic theory of pulmonary emphysema. *Am. Rev. Tuberc.*, June, 1937, *35*, 730–739.

Emphysema in its earlier stages is confined to the anterior pulmonary margins and is more

developed in the lingula of the left lung. The several current theories of emphysema fail to explain this localization of early emphysema in the paracardiac pulmonary lobules. The normal contractions of the heart actuate the contiguous pulmonary lobules, the systolic contraction causing an inspiration, the diastolic dilatation causing an expiratory movement. With large hearts and during physical exercise, this cardiorespiratory activity of the anterior pulmonary margins may equal or exceed the activity caused by the respiratory movements of the chest wall. The anterior pulmonary margins, particularly that of the left lung, being the most exercised regions of the lungs, become the favorable seat of pulmonary emphysema.

Valvular diseases of the heart and functional diseases associated with enlargement and increased cardiac output increase the tendency to emphysema and are quite generally associated with advanced emphysema. The enlargement of the right side of the heart found in cases of hypertension and in aortic disease is to be attributed to the associated pulmonary emphysema.—*L. H. Osmond.*

KOROL, EPHRAIM. Emphysema of the artificial-pneumothorax lung. *Am. Rev. Tuberc.*, April, 1937, *35*, 530–537.

In certain cases of artificial pneumothorax, there develop in the treated lung areas of great radiolucency, which on the roentgenogram may appear brighter than the air of the contiguous pneumothorax. This phenomenon is caused by the following factors: (1) a progressive pachypleuritis which thickens the pleura overlying the pneumothorax but spares the treated lung due to preëxistent adhesions; (2) areas of vicarious emphysema in the adherent lung; (3) air-pockets between strands of adhesions or between the lung and the visceral pleura.—*L. H. Osmond.*

LESLIE, CHARLES J. Pulmonary echinococcosis. *Am. J. Dis. Child.*, June, 1938, *55*, 1267–1272.

Leslie reports a case of primary bilateral pulmonary hydatid cysts in a child of seven years. Infestation by *Echinococcus granulosus* is uncommon in the United States. In Leslie's comment on this case he suggests that the correct diagnosis should have been made, or at least suspected, before thoracentesis was performed. Empyema was suggesged on the patient's admission by the history of spiking fever, cough and sweats following a reported pneumonia and by the physical signs of fluid at the base of one lung. However, too little attention was paid to the obscure physical signs in the other lung. The roentgen picture of circumscribed spherical density in the parenchyma of each lung should have suggested the diagnosis.

The paper is well illustrated by roentgenograms of the chest showing the various stages of the disease. Leslie thinks the recognition of future cases will depend largely on correct interpretation of the roentgen picture.

Had the condition been suspected, thoracentesis would certainly not have been done, Leslie states, before specific serologic tests had been employed. All authorities have deplored this procedure because of the danger of disseminating scolices and of causing severe anaphylactic shock. His patient had a severe toxic reaction after aspiration, although the fluid was apparently sterile. The rarity of secondary implantation following rupture of pulmonary cysts has been pointed out, although this occasionally does occur.—*R. S. Bromer.*

CHARR, ROBERT. Carcinoma of the bronchus in association with anthracosilicosis. *Am. J. M. Sc.*, Oct., 1937, *194*, 535–541.

Generally, post-mortem reports have indicated that there is no relationship between pneumonoconiosis and pulmonary new growths. Between January, 1934, and December, 1936, 174 cases of anthracosilicosis, with or without tuberculosis, were treated at the White Haven Sanatorium. Thirty-six of these came to necropsy. Of these, 4 were found to have primary carcinoma of a bronchus.

The outstanding symptoms included dyspnea, hemoptysis, cough, expectoration and pain in the chest. Suspicion of primary malignancy was excited in such cases when sputum examinations were negative for the tubercle bacillus. Because of the anthracosilicosis, roentgenological diagnoses were difficult for establishing the presence of malignancy. Three of the 4 cases showed evidence of atelectasis; the other showed pleural effusion.—*A. A. de Lorimier.*

PORTER, R. E., and GORDON, WM. H. The size of the heart in pulmonary tuberculosis. *Am. Rev. Tuberc.*, July, 1937, *36*, 82–89.

A study was made of the teleroentgenograms of 400 patients having all types of pulmonary

tuberculosis. A comparison was made between the measured transverse diameter of the heart and the predicted transverse diameter. This study showed that the heart of the individual having pulmonary tuberculosis is not smaller than the predicted normal on the basis of weight, height and age.—*L. H. Osmond.*

Nemet, Geza, and Rosenblatt, Milton B. Cardiac failure secondary to chronic pulmonary tuberculosis. *Am. Rev. Tuberc.*, June, 1937, *35*, 713–729.

A study of 71 patients who came to necropsy revealed 46.5 per cent with right ventricular hypertrophy. None of these cases were associated with any significant pathological change other than pulmonary tuberculosis, all of which had extensive bilateral involvement and one-third showed definite hematogenous lesions.

Twenty-two of the 33 cases of hypertrophy of the right heart were not diagnosed before death. It is felt that the inability to distinguish clinically between pulmonary insufficiency and cardiac insufficiency was largely responsible for the low percentage of diagnoses.

The cardinal sign of right ventricular failure is enlargement on roentgenoscopy or the roentgenogram.—*L. H. Osmond.*

Fox, John P., and Hospers, Cornelius A. Solid teratoid tumors of the anterior mediastinum. *Am. J. Cancer*, Oct., 1936, *28*, 273–290.

The complete autopsy report of each case is included. The outstanding features of the first case were: the Froehlich syndrome which underwent spontaneous regression before the onset of the tumor symptoms; lack of response to roentgen therapy, the widespread bone marrow metastases of the sarcomatous portion of the tumor.

The second case, which microscopically was a liporhabdomyosarcoma, proved to be larger than any mediastinal tumor previously recorded. The tumor, which almost filled the thorax, measured 33×30×16 cm. and weighed 9 kg.

Thirteen illustrations of chest films, gross specimens and photographs along with a generous bibliography are included.—*J. S. Weber.*

Schlomka, G., and Daum, H., Ueber die Spontanschwankungen der Herzgrösse beim Gesunden. (Normal spontaneous variations in the size of the heart.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, June, 1937, *55*, 558–569.

The subjects were for the most part healthy males between the ages of nineteen and forty-five. The exposures of the chest were made at 4-5/100 second at a distance of 1.5 meters (but computed for a distance of 2 meters) and with the subject holding his breath at the end of a deep but not maximum inspiration. Only the usual simple measurements, Ml and Mr were obtained in the usual manner and the sum taken as the transverse diameter, Tr. Note was also made of the subject's age, weight, arterial pressure, pulse rate, and the interval since the last examination.

In 116 reported observations the percentage exhibiting differences between the first and second measurements was as follows:

| | |
|---|---|
| 0–0.5 cm. | 49.5% |
| 0.5–1.0 cm. | 30.2% |
| 1.0–1.5 cm. | 16.4% |
| 1.5–2.0 cm. | 3.3% |
| over 2.0 cm. | 0.8% |

The size of the heart had no significant relation to the magnitude of the variation between measurements. Increasing age produced only a very slight increase in the variability of the heart size.

In spite of the attempt to make the exposures in the same phase of respiration, there were appreciable differences in the height of the diaphragm on repeated exposures. When the diaphragm was higher on a subsequent examination, the transverse diameter of the heart increased. However, an average difference of 1 cm. in the height of the diaphragm resulted in only 0.1 cm. difference in the heart size.

Those subjects gaining weight between the observations showed a slight increase in the heart size, but there was no significant change in those losing weight during the interval. Only slight variations in pulse rate were observed and there was no close correlation between this variation and the variation in the size of the heart.

In his kymographic studies, Stumpf observed a difference between systolic-diastolic diameters of over 1 cm. in only 2 per cent of the cases. In this series a difference of more than 1 cm. was observed in over 20 per cent of the cases so that one cannot explain the difference by assuming it was due to the exposure being made in a different phase of the cardiac cycle.

Furthermore, of two exposures it is highly improbable that one would be made in diastole and the other at the extreme end of systole.

Although finding no explanation for the variability of the heart size, the author points out that it does exist and should be given more consideration in the setting up of normal standards and in testing the effects of therapeutic procedures.—*W. A. Evans, Jr.*

COHEN, JACOB N., and LEVINE, HARRY S. Calcification of myocardium with bone formation. *Arch. Int. Med.*, Sept., 1937, *60*, 486–493.

The authors claim that they have been able to find only 5 other cases such as this one, reported in the literature, where calcification of the myocardium has progressed into actual bone formation. Scholz reviewed the literature up to 1924, grouping calcifications in the heart as follows: myocarditis, 14 cases; obliteration of coronary arteries, 3 cases; sepsis, 5 cases; calcium metastasis, 4 cases and direct extension from calcifying pericarditis, 4 cases. Diamond collected reports of 14 additional cases of myocardial calcifications including 1 of a premature infant who had died thirty minutes after birth; calcium deposits were found in the walls of both ventricles. A number of other cases have subsequently been reported but mention of actual bone formations has been rare.

The authors' case was of an Italian widower, aged sixty-four, whose chief complaint was of abdominal distention. He had been an excessive wine drinker (two or three bottles daily) since the age of thirty and he smoked from eight to ten Italian cigars a day. He was the father of 12 children, having married at the age of eighteen, and he had been a hard worker all his life. Past history was entirely negative until about eight months previously when he had been hospitalized because of abdominal distress and distention. Abdominal paracenteses afforded only temporary relief. Percussion outline of the heart suggested enlargement. There was a faint systolic murmur over the apex and aortic areas. The superficial veins over the thorax and abdominal wall were dilated and edema was noted in the sacrum, thighs, scrotum and ankles. Five gallons of fluid were removed from the abdominal cavity and during a month of hospitalization, before his death, a total of 14 gallons was removed by abdominal paracenteses. The icteric index ranged around 38; urobilinogen was increased in the urine and bile and albumin were present. The Wassermann reaction was negative. The blood pressure never rose over 110 systolic while the diastolic remained in the 70's. The pulse rate was between 90 and 100. Roentgenography revealed a conspicuous bulge in the left border of the heart which was outlined by a dense calcific opacity. Oblique projections and fluoroscopy visualized this density to be anterior to the aorta. The diameters of the heart were increased in all directions. Discrete calcifications were visualized in both hilar regions and the aorta also appeared sclerotic. The electrocardiogram revealed evidence of myocardial damage.

Post-mortem anatomical diagnoses included "aneurysm of the left ventricle, severe sclerosis of the coronary vessels, myocardial calcification of the left ventricle, arteriosclerotic aortitis with ulcerations, anterior and lateral pericardial adhesions." The heart weighed 800 grams. The aneurysmal sac was about as large as a fist and occupied the distal three-fifths of the left ventricle. It showed a diffuse calcification. The ventricle wall elsewhere showed marked fibrosis. All valves were relatively normal. The distal two-thirds of the left coronary artery was obliterated by sclerosis.—*A. A. de Lorimier.*

CUSHING, E. H. Diverticulum of the pericardium. *Arch. Int. Med.*, Jan., 1937, *59*, 56–64.

The author was able to find 40 cases of diverticula of the pericardium reported in the literature. Many of these were considered to be of congenital origin as no pathological changes could be found. Some appeared to be formed by external traction. They varied in size from that of a pea to as large as 12 cm. in length; 52.5 per cent of them presented to the right.

Clinically, most of the cases were considered to have an enlarged heart or mediastinal tumor. Roentgenographically, aortic aneurysm or dermoid cyst in the mediastinum might be suggested. Jansson noted that with deep inspiration a pericardial diverticulum becomes long and narrow, and with expiration it becomes rounder, shorter and broader.

The author's case was of a forty-three-year-old Negro laborer whose complaint was of aching pains in the right side of the chest. Roentgenographically there was found a rounded density along the right side of the cardiac silhouette which showed an indefinite pulsation and which appeared to displace the heart to the

left and posteriorly. There was some calcific flecking of the pericardium. This patient was not seen for an interval of four years when he returned because of a swelling to the right of the sternum which he said reappeared, regardless of his doctor having repeatedly withdrawn clear yellow fluid. Preliminary roentgenography showed little change in the intrathoracic densities, though there appeared to be more calcifications in the pericardium; 180 cc. of yellowish fluid was extracted and 50 cc. of air was injected. Subsequent roentgenography showed that part of this air remained in the tumor region and part had extended into the true pericardial region. The aspirated fluid showed some involuted acid-fast forms and when inoculated into guinea pigs, typical acid-fast lesions were produced. Electrocardiograms showed an elevated T-wave in the fourth lead.—*A. A. de Lorimier.*

Cushing, E. H., and Moritz, Alan. Diverticulum of the pericardium; further data showing presence of extrathoracic abscess. *Arch. Int. Med.*, Sept., 1937, *60*, 482–485.

One of the writers previously reported this case with details concerning a diagnosis of pericardial diverticulum. The patient was then living. Ten days previous to the last admission to the hospital there had been hemoptysis of about 500 cc. Blood and sputum analyses showed pneumococci Type II and there was clinical evidence of involvement of both lower lung fields. The patient died the day following this hospitalization. In addition to the pulmonary and other findings, post-mortem studies revealed "chronic tuberculous pericarditis with anterior extrathoracic pseudo-diverticulum (communicating abscess) of the pericardium" and "chronic cardiac compression, with extreme cardiac deformity." The extension of this pericardial abscess had caused destruction of the cartilage of the fourth rib but there was no invasion of bone. The superficial portion measured about 4 cm. in diameter; its apex extended about 2.5 cm. beyond the thoracic wall and beneath the pectoralis major muscle. A narrow sinus tract connected this portion with the intrapericardial abscess. Posteriorly, inferiorly and laterally, in relation to the heart, the pericardial sac was obliterated with fibrous adhesions containing calcareous material. The abscess pocket, located anterior to the heart, contained about 350 cc. of thin cloudy brown fluid. Microscopical studies of the parietal pericardium and the wall of the communicating extrathoracic abscess revealed active solitary and conglomerate tubercles. No evidence of tuberculous involvement could be found elsewhere. —*A. A. de Lorimier.*

Wallace, Robert P. Traction diverticulum of the esophagus. *Arch. Int. Med.*, Sept., 1937, *60*, 454–457.

Twenty-six cases of traction diverticula were analyzed as to associated symptomatology. Ten of these (38.5 per cent) complained of symptoms which seemed to be attributable to the diverticula. Substernal weight or heaviness was complained of by 4; burning, by 3; choking and sticking sensations were less common complaints. In most instances these sensations appeared to be within the chest, but in 2 cases there was radiation laterally to the ribs below the axilla and in 2 others, to the interscapular region. Painful swallowing was claimed by 6 and in several instances it was necessary to restrict the diet to liquids and soft foods. Hematemesis occurred in 3 cases. Eructations, simple vomiting, hiccup, epigastric pains and weakness were occasionally mentioned.

This group included about two and a half times as many males as females. The same proportion held for those with symptoms as for those without. Only 2 of the cases showed multiple diverticula but these did not complain of symptoms. There did not appear to be any relationship between the size of the diverticula and association of symptoms.—*A. A. de Lorimier.*

Schneider, Louis, and Segal, Jacob. Bronchography with iodized oil not without danger. *Am. Rev. Tuberc.*, April, 1937, *35*, 590–595.

To the knowledge of the authors, there has been no reported instance of pulmonary tuberculosis following the injection of lipiodol into the bronchi of apparently normal lungs. Sweany has shown that many a small encapsulated focus containing tubercle bacilli will not be seen by the roentgen ray, although autopsy examination reveals it macroscopically with ease. He also points out that our present technique is not developed enough for roentgen delineation of small early lesions. It is very possible that such an invisible encapsulated focus existed in the lung of one of the patients reported at the time of the first examination, and

that the prolonged presence of lipiodol reactivated this nonclinical process and converted it into manifest disease.

It has been the experience of the authors, as well as others who practice this procedure extensively, that, after bronchography, the iodized oil disappears from the pulmonary system within a few weeks at the most; only occasionally is it retained a few months; rarely more than a year. The authors' case is remarkable in that oil is still noted about two years after injection and that clinical tuberculosis developed more than a year after bronchography, the process starting around an area of retained lipiodol.—*L. H. Osmond.*

ABDOMEN

BAYER, L. Über eine Moglichkeit klinisch-röntgenologischer Unterscheidung zwischen gutartigen und bösartigen Geschwüren des Magens. (Concerning the possibility of a clinical-roentgenological differentiation between benign and malignant ulcers of the stomach.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1937, *55*, 51–56.

It is often impossible to recognize the early malignant degeneration of a gastric ulcer, and even primary carcinomatous ulcers are difficult to distinguish from peptic ulcer craters. Even observation and palpation of the specimen by the surgeon may not reveal the true diagnosis. The kymograph is helpful in the early recognition of the submucous infiltration by carcinoma, although one should not forget that the scarred ulcer also hardens the stomach wall and limits the normal movements. If one agrees that both the callous and carcinomatous ulcers should be treated surgically, then the preoperative diagnosis is not so important.

The experiences of the author lead him to recommend a test treatment for all cases where the character of the ulceration is in doubt. This test consists in the early morning ingestion of 200 cc. of a 0.25 per cent larokain solution (nontoxic local anesthetic) consumed during one hour, bed rest in the most favorable position and a moderate ulcer diet followed for periods of ten or twenty days. The symptomatic change and any alteration in the roentgenographic appearance are observed after these intervals. Acute and simple chronic peptic ulcerations always show improvement under this regimen. The callous and the carcinomatous ulcers do not respond. They can be distinguished from each other only by histological examination.—*W. A. Evans, Jr.*

SCHLOSS, J., ETTINGER, A., and PRATT, J. H. Diagnosis of diseases of the stomach by gastroscopic and x-ray relief studies. *Am. J. M. Sc.*, Feb., 1937, *193*, 171–180.

Morphological evidences of the condition of the wall of the stomach as obtained by roentgen examinations and gastroscopy have supplanted dependence upon symptoms and tests of function, in establishing diagnoses of stomach diseases. In many European clinics, both roentgenological and gastroscopic studies are made. In the United States it is far less common that both of these procedures be followed routinely and for this reason the authors have analyzed their findings in 100 cases which were studied by both methods.

The efficiency of modern roentgenological studies of the stomach has been increased by the application of these four principles: (1) the use of a small amount of opaque medium in order to maintain some degree of transparency; (2) application of graded compression—to fill depressions regional to prominences of the mucous membrane; (3) fluoroscopy of the patient in various positions so as to visualize contours in different planes, and (4) the making of spot films during fluoroscopy—for permanent records of fleeting observations.

Gastroscopy accomplishes an inspection of the stomach mucosa without surgical exploration. The difficulty of this procedure has been decreased since the innovation of a flexible instrument. Preliminary studies of the stomach and esophagus should be made fluoroscopically and perhaps by esophagoscopy in order to lessen the danger of perforation because of resistance by an obstructive lesion.

Roentgenological studies present information as to the shape, size, contour, tone, motility, peristalsis and position of the stomach. They also indicate the degree of gastric secretion and the emptying time. They should reveal large and medium sized defects on the walls and, with the application of relief technique, they should also reveal comparatively coarse changes of the mucosa and the mucosal folds. Gastroscopy should demonstrate even very fine changes and defects of the surface, showing the folds in their natural appearance. It demonstrates the color of the mucous membranes, hemorrhages, etc., and may even give some im-

pression as to tone, peristalsis and gastric secretion. In general, the two methods supplement each other.

The 100 cases, studied by both methods, were divided into six groups. Group 1 included 25 cases which, by roentgenological studies, appeared to be normal or have only functional disturbances. Gastroscopy showed that about two-thirds of these warranted treatment other than "psychotherapy." Group 2 included 3 cases of extragastric lesions. In 1 of these, the diagnosis was reached by combined roentgenological and gastroscopic studies. Group 3 included those cases in which diagnosis "gastritis" was the sole opinion. Roentgenologically this diagnosis depended upon indirect signs such as hypersecretion, hyperperistalsis, broadening and increased rigidity of the rugae; seldom, upon demonstration of the so-called "granulated relief." Gastroscopically, diagnostic criteria included: "spongy velvet-like appearance" of the surface, edema, circumscribed hyperemia, old and fresh hemorrhages, verrucous swellings, erosions, atrophic areas, etc. The features considered roentgenologically could also be seen. Gastroscopic studies showed a percentage error in the roentgenoscopic interpretation of "hypertrophic" gastritis, based upon thickened folds; the apparent thickenings are probably due to changes in the submucosa and muscularis mucosa and occasionally atrophy rather than hypertrophy of the mucosa actually exists. The term "chronic gastritis" is used by the authors; it includes superficial, hypertrophic and atrophic forms, these changes being described in gastroscopic reports. Small ulcerations (more deeply penetrating than "superficial erosions" —the latter being considered in the group of superficial gastritis or chronic gastritis) were found with the use of the gastroscope, in 18 cases (Group 4). Only 11 of these were recognized roentgenologically. In cases of duodenal ulcer, the gastroscopic evidence may include findings of gastritis and a deformed pylorus. Tumors such as polyps and carcinoma are included in Group 5. One case which was considered to have an infiltrating carcinoma was diagnosed "localized inflammation" by gastroscopic examination. Surgical intervention was therefore opposed and the patient gained 25 pounds during the following year. Gastroscopy seemed to aid in determining the nature and extent of other lesions which were picked up roentgenographically, and in many instances very small lesions were found by the direct visualization which were not noted during the roentgen studies. Group 6 included the postoperative cases. Gastroscopy revealed a high percentage of gastritis. Roentgenography was necessary for study of an anastomosed intestine, though the region of the stoma was studied equally well by either method.—*A. A. de Lorimier.*

Lieber, Marshall M., Stewart, Harold L., and Lund, Herbert. Carcinoma of the infrapapillary portion of the duodenum. *Arch. Surg.*, Aug., 1937, *35*, 268–289.

A clinical and pathologic study is presented of 30 cases of carcinoma of the infrapapillary portion of the duodenum—2 new cases and 28 selected from the literature.

The clinical onset was acute in 40 per cent of cases, with an average duration of four months; it was gradual throughout in 40 per cent, with an average duration of eleven months, and first gradual and then acute in 20 per cent, with an average duration of ten months, the gradual phase occupying four and a half months. The principal symptoms and signs, irrespective of the mode of onset, were pain, vomiting and cachexia. Other less common symptoms included anorexia, constipation, diarrhea, abdominal distention and jaundice. The vomitus or gastric contents were analyzed in 20 cases, and bile was detected in 70 per cent of these and blood in 35 per cent; free hydrochloric acid was absent in 57 per cent of 14 specimens. A mass in the region of the primary tumor was palpated clinically in 16.6 per cent of the cases.

A correct preoperative clinical diagnosis is rarely made. An obstructing lesion of the duodenum was visualized roentgenographically with a fair degree of accuracy in 40 per cent of 15 cases; in 33 per cent the lesion was incorrectly localized at or near the pylorus, and in the remainder no lesion was demonstrated. A correct diagnosis was made at laparotomy in 61.9 per cent of 21 cases, the results being unsatisfactory in 81 per cent of these, and the postoperative follow-up studies were incomplete in the remainder.

The primary tumor measured from 3 to 5 cm. in length in the majority of cases, and in one case the infrapapillary segment of the duodenum was involved diffusely in its entirety. All the tumors were of the glandular carcinomatous variety. The descending and ascending portions

of the infrapapillary segment were most frequently involved. Extension of the primary tumor to adjacent structures and organs and metastases or both occurred in 50 per cent of cases. Some degree of obstruction of the terminal end of the common bile duct or of the ampulla of Vater or both occurred as a terminal feature in 16.6 per cent. Duodenal fistulas existed in 13.3 per cent. A high grade of intestinal obstruction was present in 56.6 per cent. The alimentary canal proximal to the primary duodenal lesion was maximally distended, the stomach and proximal portion of the duodenum often giving the appearance of a bilocular viscus.—*L. H. Osmond.*

STEWART, HAROLD L., and LIEBER, MARSHALL M. Carcinoma of the suprapapillary portion of the duodenum. *Arch Surg.*, July, 1937, *35*, 99–129.

This study of carcinoma of the suprapapillary portion of the duodenum represents a clinical and pathologic correlation based on 6 new cases and 35 cases reported in the literature; references to 68 additional cases reported as examples of this condition are listed.

The onset was acute in 53.6 per cent of cases and gradual in 41.4 per cent, an antecedent history of symptoms referable to the upper portion of the abdomen being elicited in approximately half of the cases in which the onset was acute and in several in which it was gradual. The symptoms occurring most frequently in the cases in which the onset was acute were vomiting, epigastric pain, weakness, loss of weight and jaundice, and the average duration of life was three and a half months. The early symptoms occurring most frequently in the cases in which the onset was gradual were abdominal pain, dyspepsia, loss of weight, vomiting and jaundice, and the average length of life after the onset was sixteen months. A marked change in symptomatology occurred in 62 per cent of the cases in which the onset was gradual, symptoms occurring which resembled those in the group in which the onset was acute. A mass was palpated clinically in the region of the primary tumor in approximately 24 per cent of the cases. The gastric or duodenal contents contained blood in 8 of 13 cases, free hydrochloric acid in 7, and bile in only 1 in which cholecystogastrostomy had been performed. The stools contained blood in 13 of 21 cases, and 9 were acholic; typical "pancreatic" stools were found in 1 case in which the duct of Wirsung was obstructed. A marked grade of anemia was present in 10 cases, the color index being low in 7 and high in 3. Roentgenographic studies are of little direct value in making a positive diagnosis of carcinoma of the suprapapillary portion of the duodenum. In a few cases evidence of an ulcerated lesion in the duodenum or of obstruction of the gastrointestinal tract was suggested but, on the other hand, extensive constricting lesions were frequently not demonstrated. Irrespective of the anatomic point of obstruction, the findings are frequently interpreted as pyloric obstruction. This method of examination is of greatest value in ruling out lesions of the stomach, colon or gallbladder.

A correct preoperative clinical diagnosis of carcinoma of the suprapapillary portion of the duodenum was made only twice. A correct surgical diagnosis was made in 9 of 17 cases, biopsy being of especial value in this connection. No instance of cure has been recorded, although follow-up studies were incomplete in a few cases.

The growth averaged 2.5 cm. in length in 56.1 per cent of cases and varied from 4.5 to 8 cm. in length in 31.7 per cent. It was localized in 68.3 per cent of cases, and in one-half of these to the bulbar region. Ulceration occurred in about 73 per cent of cases, about half of these being annular or constricting lesions. Extension or metastasis occurred in 75.6 per cent of cases, to the liver, lymph nodes, biliary passages, peritoneum, lungs and bone. All the growths were adenocarcinoma but one, which was an adenosquamous cell carcinoma.

No definite evidence has been advanced to support the hypothesis that simple ulcer of the duodenum is a precancerous lesion.—*L. H. Osmond.*

JACKSON, ARNOLD S. Regional enteritis. *Surg., Gynec. & Obst.*, July, 1937, *65*, 1–10.

The author collected a total of 219 cases including those from the literature and 4 of his own, reported since the condition was first described by Crohn in 1932. He stresses the similarity to appendicitis and offers this as an explanation of the persistence of abdominal pain, etc., following the removal of the appendix.

The grouping first described by Crohn is employed, i.e., Group 1, in which the symptoms simulate those of an acute abdominal inflam-

mation. There is pain and tenderness in the right lower quadrant, accompanied by cramps, fever and leucocytosis. Group 2—ulcerative stage. There are diarrhea and cramp-like abdominal pain, with mucous and occasionally blood in stools, anemia, loss of weight, malaise and slight fever. Group 3, the stenotic stage in which the lumen of the bowel gradually becomes constricted. Symptoms are those of partial, small intestinal obstruction—cramps, vomiting, constipation. Group 4. In this stage multiple fistulas are found that may open either internally or externally.

Determination of the diagnosis depends upon the roentgenologist. In the early stage the roentgenogram may reveal no characteristic lesion but as the chronic stenotic form develops a filling defect in the terminal ileum with a mild ileal stasis and distention proximal to the defect appears. In cases with still greater stenosis, the lumen shows merely as a fine line of barium. Kantor has called attention to three other significant roentgenological findings, namely, a filling defect just proximal to the cecum; an abnormality in contour of the last filled loop of ileum, and dilatation of ileac loops just proximal to the lesion.—*J. H. Vastine.*

Fox, N. I., Warfield, C. H., and Leader, L. O. Tuberculous enterocolitis. 1. A study of the terminal ileum and colon by barium meal and barium enema. *Am. Rev. Tuberc.*, Feb., 1937, *35*, 198–207.

One hundred consecutive cases of pulmonary tuberculosis were studied. The technique employed was as follows: A standard prepared meal of barium sulphate was given seven hours before the first observation. Another observation was made at nine hours. A barium enema was done in 67 cases. The findings and signs of tuberculosis coincide with those reported by other authors.—*L. H. Osmond.*

Jacobi, Harry G., and Lust, Franz J. Roentgenographic studies of the mucous membrane of the colon. III. Mucosal detail studies as an aid in the early recognition of carcinoma of the colon. *Am. J. M. Sc.*, April, 1937, *193*, 510–515.

Too often, early lesions of the colon are not visualized by the ordinary barium enema or by studies made after the oral administration of barium. Spasms, adhesions, malpositions and redundancies are some of the factors which complicate these studies. Fischer's double contrast method affords visualization of such intraluminal lesions as polyps, adenomas and early fungating neoplasms. This method also improves the visualization of constricting lesions. Oblique projections, as advocated by Stewart and Illick, are of value in separating the coils of the sigmoid, in studying the contours of a low-fixed cecum or the posterior walls of the rectum. The ordinary filling of the colon usually so distends it that only the edges are visualized.

The authors advocate the following precautions and procedures: low residue diet for twenty-four hours preceding the examination; milk of magnesia or cascara, the night before; two enemas, given at an interval of one hour (using castile soap and water), the second enema being accomplished two to three hours before the examination; the barium enema to consist of 1 quart of barium mixture in plain water—no milk or mucilage; slow administration of the enema under fluoroscopic control; discontinuance of the injection as soon as the head of the barium column reaches the hepatic flexure, then turning the patient on his right side; recording one film; allowing evacuation and rechecking fluoroscopically until enough of the barium has been passed so as to visualize a mucosal relief. This careful procedure may require thirty to forty-five minutes and must be conducted by a physician. Three case studies are cited as examples. The diagnoses had been missed in these, by the ordinary methods, but early carcinomata were recognized after gaining mucosal detail, and surgery was accomplished early enough to be successful.—*A. A. de Lorimier.*

Ferris, Henry W. Calcified lesions of primary tuberculosis in the intestine in adults. *Am. Rev. Tuberc.*, June, 1937, *35*, 794–804.

In a small number of cases with caseous calcified or calcified lesions of mesenteric lymph nodes, a healed and calcified primary lesion of tuberculosis may be found in the intestine. This lesion may be easily overlooked, and the failure to find it may be incorrectly interpreted as evidence that tubercle bacilli have passed through the intact intestinal wall to the mesenteric lymph nodes. Tuberculous lesions of intestinal wall and adjacent lymph nodes are comparable to similar lesions of lungs and tracheobronchial lymph nodes (primary complex). With a primary complex in the intestine and mesentery,

lesions of first infection by way of the lung are likely to be absent.—*L. H. Osmond.*

JOHNSON, JULIAN; ELLIS, ALFRED L., and RIEGEL, CECELIA. Studies of gall bladder function. XIV. Absorption of sodium tetraiodophenolphthalein from the normal and damaged gall bladder. *Am. J. M. Sc.*, April, 1937, *193*, 483–488.

Failure to visualize the gallbladder, after administration of sodium tetraiodophenolphthalein, is usually considered to be due to (*a*) failure of absorption of the dye from the gastrointestinal tract; (*b*) failure of the liver to excrete the dye in adequate amounts; (*c*) incompetence of the sphincter of Oddi; (*d*) obstruction of the cystic duct, or (*e*) a degree of cholecystitis which does not permit of concentration of the dye in the gallbladder. Igwanaga found that bacterial or mechanical inflammation of the gallbladder mucosa increases the rate of absorption of phenolsulphonephthalein, methylene blue and indigo-carmine. Winkenwerder showed that slight injury of the wall resulted in rapid absorption of the Prussian blue reagents. Johnson found that injury to the mucous membrane of the gallbladder was produced if sodium tetraiodophenolphthalein were dissolved in gallbladder or hepatic bile and injected directly into the gallbladder. Moreover, this bile developed a dirty bluish tinge. However, if the dye were injected intravenously, no change in the color of the bile was noted. It therefore seemed that some toxic feature of the dye was modified when given orally or intravenously.

Knowing these facts, the authors carried out the following: Bile was obtained from the gallbladder or hepatic ducts of dogs which had been given the dye intravenously; after ligation of the cystic duct of another dog, a known aliquot of the iodinized bile was injected into the gallbladder; after twenty-four hours, this animal was sacrificed and the gallbladder content analyzed; the results of 12 such tests showed recovery of 83 to 106 per cent of the injected iodine—showing that very little or none of it was absorbed. The mucous membrane of the gallbladders of another group of 5 dogs was injured by the method of direct injections of the dye, and later the iodinized bile was injected in the same way. For these, there was recovery of only 31 to 63 per cent of the iodine after twenty-four hours. Injury was produced upon the mucous membranes of the gallbladders of another group of dogs by injecting 5 cc. of a 10 per cent sodium chloride daily for two or three days and the same procedure of injecting iodinized bile again carried out. From these only 13 to 57 per cent of the injected iodine was recovered. Gangrenous gallbladders were produced in a fourth group by first ligating the cystic vessels. Only 5.8 to 29 per cent of the injected iodine was recovered after a period of twenty-four hours following the same procedure of injecting the iodinized bile. These observations have led the authors to believe that a damaged gallbladder more rapidly absorbs the dye and that the rapid changes by the normal gallbladder, occurring in clinical cholecystography, must be explained upon the basis of expulsion of the dye through the cystic duct rather than absorption of the dye by the gallbladder.—*A. A. de Lorimier.*

### GENITOURINARY SYSTEM

RYTAND, DAVID A. Roentgenographic study of orthostatic albuminuria by means of injections of diodrast. *Arch. Int. Med.*, May, 1937, *59*, 837–856.

Orthostatic albuminuria has been explained on the basis of a high pulse pressure (the circulatory theory) and mechanical embarrassment of circulation (the mechanical theory). The author believes that diverse anatomical anomalies may be responsible and the condition cannot be considered to be a distinct entity.

Five young men, known to have orthostatic albuminuria, were studied fluoroscopically and roentgenographically after the injection of diodrast. After a night's rest in bed, each subject was taken to the roentgenological department in a supine position, diodrast was injected and roentgenograms were taken without permitting a change in the subject's position. The subject then walked around for an hour and a half and diodrast was again injected while the subject was erect and further roentgenography accomplished. Fluoroscopic studies were also made. In 2 of the subjects, when in the supine position, diodrast appeared normally in both kidneys; when they were erect it appeared in low concentration in the left kidney, which became larger. In the other 3 subjects, posture did not significantly alter the excretion of diodrast unilaterally. One of these subjects had a very small left kidney and a large right one, and a second had a reduplicated left ureter and renal pelvis and a mobile right kidney. It was

thought that in the case of the two which showed delayed excretions of the diodrast and coincident enlargements of the left renal outlines that likely the mechanical theory applied and that there had resulted a compression of the left renal vein (between the superior mesenteric artery and the aorta) when in the standing position. Perhaps the other anomalies explained the other 3 cases.—*A. A. de Lorimier.*

Donaldson, S. W., and Howard, S. C. Primary carcinoma of the adrenal. *Am. J. Cancer*, May, 1935, *24*, 75–77.

The pertinent clinical roentgen and autopsy findings of a primary carcinoma of the adrenal in a female are given. There is nothing new offered and the report is made merely to record the case.—*J. S. Weber.*

SKELETAL SYSTEM

Cole, James Pierce. Dislocation and fracture-dislocation of lower cervical vertebrae. *Arch. Surg.*, Sept., 1937, *35*, 528–547.

Closed reduction of a fracture-dislocation or dislocation of the cervical portion of the spine in many instances fails to restore the patient to normal. The disability of the patient should be estimated in regard to the degree of involvement of the vertebral column, the nerve roots or the cord. The type of involvement of the cord is difficult to ascertain in a case of a lesion of this nature. An ununited fracture of the vertebral arch is common in such cases and is difficult to diagnose. Hypermobility of the luxated vertebra is the cause of involvement of the nerve roots in many cases.

Natural fusion of the vertebral bodies of the involved vertebra does not occur in a number of cases. Spinal fusion of the cervical region is not a dangerous procedure in experienced hands. Spinal fusion is of little value in the treatment of syndromes arising from involvement of the cord, but, if possible, a combined laminectomy and spinal fusion should be attempted in the presence of involvement of the cord and anterior vertebral displacement. If laminectomy is done, the coverings of the cord should be freely opened if they are at all thickened. Spinal fusion relieves a patient of symptoms referable to the vertebral pathologic processes and is the only adequate means to stabilize a hypermobile luxated vertebra.

The mobility of the head and neck is not materially limited by fusion of three or four cervical vertebrae. Anterior vertebral tilt and displacement without mobility play little part in the production of nerve root syndromes.—*L. H. Osmond.*

Aitken, Alexander P., and Childress, Harold M. Intra-articular displacement of the internal epicondyle following dislocation. *J. Bone & Joint Surg.*, Jan., 1938, *20*, 161–166.

Intra-articular displacement of the internal epicondylar epiphysis may complicate elbow dislocations in children with injury to the ulnar nerve. Post-reduction roentgenograms of all elbow dislocations should be taken to rule out this complication. The authors advocate immediate surgical reduction. If the medial joint space is widened during manipulation, it is possible sometimes to secure a closed reduction. They also advocate anterior transplantation of the ulnar nerve, whether the epicondyle is excised or reattached. They have secured excellent results if the condition is treated promptly and correctly.

The usual mechanism is a fall on the hand with the forearm abducted and the elbow slightly flexed, causing posterior or posterolateral dislocation of the elbow. Such a fall also exerts a pull upón the common flexor tendon and the ulnar collateral ligament, both of which are attached to the internal epicondyle, and as a result avulsion of the epicondyle at the epiphysis occurs. The fragment is then pulled downward and forward by the flexors, and the entire fragment, free of the humerus, is then carried backward and laterally with the displaced ulna, so that it lies posterior to the trochlea and anterior to the semilunar notch of the ulna.

In the roentgenograms the medial widening of the joint space with an absence of a normally situated medial epicondyle is diagnostic. The fragment is usually seen, plainly interposed between the trochlea and the olecranon. This finding is not always present, however, since in patients under seven years of age the median epicondyle consists almost entirely of cartilage.

Immediate ulnar nerve signs are not usually present unless the nerve has been subjected to excessive trauma during reduction or at the time of injury. After the acute pain and reaction have subsided, the patient becomes aware of areas of anesthesia and muscle weakness.—*R. S. Bromer.*

MAGNUSSON, RAGNAR. Tuberculous osteitis of the ischium. *J. Bone & Joint Surg.*, Jan., 1938, *20*, 23–34.

Magnusson reports 8 cases of tuberculous osteitis of the ischium and 5 other cases of osteitis of the ischium of uncertain origin. Three of the latter were probably cases of clear septic osteitis. In the tuberculous cases, pain was of a mild type for a year or more, sometimes having a sciatic distribution. Later, however, localized pain over the tuber ischii was present in some of the patients. Gradually abscesses or fistulae appeared in the gluteal region. In 2 cases there was a sensation of stiffness in the hip joint on the affected side with a restriction of abduction and adduction and of the rotary movements.

He regards the differentiation between a tuberculous and a septic osteitis in the roentgenogram as impossible in the chronic stage. In some of the cases, the septic osteitis seemed to leave a more sclerotic bone delineation and sharper outlines of the area of destruction than did the tuberculous osteitis. In cases where there are roentgenographic changes in the ischium but no sequestra, it is difficult to determine whether the process is of an inflammatory nature or a tumor. Lues also must be excluded.

Of the 8 patients with certain tuberculous osteitis, 1 was treated conservatively. In 3 patients, sequestrectomy was performed. In 2 others, sequestrectomy with gouging and scraping out of diseased bone was the operative procedure. In 2 more, subperiosteal resection of the tuber ischii and the adjoining parts of the superior ramus of the pubis gave excellent results.—*R. S. Bromer.*

FUNSTEN, ROBERT V., KINSER, PRENTICE, and FRANKEL, CHARLES J. Dashboard dislocation of the hip. *J. Bone & Joint Surg.*, Jan., 1938, *20*, 124–132.

The authors state that the name "dashboard" dislocation of the hip has been chosen for the condition they describe because it points out the means by which most of the patients, upon whose case histories their paper is based, received their injuries. The person so injured was usually sitting beside the driver of an automobile when it came to an abrupt stop in a collision. In such a case, since the hip is in a flexed and adducted position, the force of the impact of the tibia or the knee against the panel is transmitted through the femur to the posterior rim of the acetabulum, and the result may be a simple dislocation or a dislocation with fracture of the lip of the acetabulum. Occasionally a fracture of the tibia or of the patella is experienced instead. This mechanism was the cause of the dislocation in 13 of the 20 cases they report. In the remaining seven, 2 patients were thrown out of automobiles; 2 were struck by automobiles; 1 fell from a tree; 1 fell from a box car; and 1 was injured at birth.

In 7 cases there was an uncomplicated posterior dislocation; in 1, an uncomplicated obturator dislocation; in 1, an obturator dislocation with an incomplete fracture of the neck; in 2, fracture of the neck and posterior dislocation; and in 9, posterior dislocation complicated by fracture of the acetabulum.

They conclude that immediate reduction and traction treatment of uncomplicated dislocation of the hip gives uniformly good results. When the dislocation is accompanied by a formidable fracture, the prognosis should be guarded because of the possibility of development of aseptic necrosis and periarticular ossification. The longer the hip stays out of place, the poorer are the prospects of obtaining a satisfactory result by operation.—*R. S. Bromer.*

BENJAMIN, BERNARD, and MILLER, PHILIP R. Hypothyroidism as a cause of disease of the hip. *Am. J. Dis. Child.*, June, 1938, *55*, 1189–1211.

The osseous changes appearing in children and resulting in the development of coxa vara in cretins have received scant attention. The authors state that in children suffering from deficient function of the thyroid gland a disturbance of ossification may occur. The maldevelopment is of two varieties. One of these affects the structure of the epiphyseal plate in such a manner as to give rise occasionally to slipping of the epiphysis. The other is in the nature of an osteochondrosis of the head of the femur. In either case deformities ensue which lead to the appearance of coxa vara.

On the basis of the osseous changes found in cretinism, the authors offer an explanation of the slipping of the epiphysis. What may be designated as a mesh type of union characterizes the junction of epiphysis and diaphysis in normal growing bones. A powerful interlocking of cartilage and bone is achieved by the interdigitation of the gear teeth of the calcified lattice with opposing filamentous processes of bone-forming marrow. In cretins, however, the

remarkably intimate association occurring at the normal epiphyseal plate is replaced by a disk type of configuration in which a flat zone of solidly calcified cartilage is in apposition with a transverse layer of bone. It is pointed out that the disk type of union may be incapable of resisting stresses which are well borne by the normal mesh type. As a result, the epiphysis in children with hypothyroidism may be dislodged. The possibility is mentioned parenthetically that the disk type or epiphyseal plate may be a factor in the etiology of slipped epiphysis in children without hypothyroidism exposed to trauma during certain periods of their development.

The second type of lesion, osteochondrosis of the head of the femur, arises from an irregular bony development of the epiphysis, with the persistence of numerous islands of uncalcified cartilage. In Perthes' disease, hips are affected which are known to have had previously normal roentgenographic architecture. The authors believe it is obvious that the islands of cartilage of the epiphysis in hypothyroidism have an entirely different origin from those found in Perthes' disease. It is only after the supervention of destructive and degenerative processes that the diseased epiphysis in hyperthyroidism begins to resemble the pathologic picture present in Perthes' disease.

The osteochondrosis of hypothyroidism is insidious in character and in the cases reported in this paper was discovered by means of roentgenograms. Subsequent examinations have led authors to the conclusion that it may be possible to detect the condition clinically. The finding in children with hypothyroidism of limitation of motion at the hip, chiefly in internal rotation, constitutes presumptive evidence of the presence of the disease of the hip.—*R. S. Bromer.*

Dittrich, R. J. Osteomyelitis of the patella. *J. Bone & Joint Surg.*, Jan., 1938, *20*, 209–212.

Dittrich reports 2 cases of primary hematogenous osteomyelitis of the patella. He states that the condition is uncommon and in many instances the diagnosis is not clear until a septic arthritis of the knee joint has occurred by extension of the destructive process. In the majority of cases the course of the infection is acute and the involvement is so extensive that all or most of the patella is extruded in the form of sequestra.

In both his patients, young males of twelve and fifteen years of age respectively, the symptoms had been of long duration but mild in character. In the second case they were so mild that the true nature of the disease was scarcely suspected. From the roentgenographic appearance, it was evident that the destructive process had been of long duration. When the diagnosis is clear it is well to eliminate the diseased areas while the process is still in the chronic stage.

The process was best shown in roentgenograms exposed with the knee flexed, the central ray being projected downward, thus securing a vertical projection of the patella with no overlying shadows of the femur.—*R. S. Bromer.*

Sontag, Lester Warren. Evidences of disturbed prenatal and neonatal growth in bones of infants aged one month. *Am. J. Dis. Child.*, June, 1938, *55*, 1248–1256.

Sontag has found lines of striae giving the appearance of thin white rings in lateral roentgenograms in the tarsal bones of infants at the age of one month. Their location and the fact that they are never present at birth indicate that the incident which incited their formation must have occurred at or immediately after birth. Bands forming the periphery of tarsal bones and apparently representing thickened zones of temporary calcification have been observed at one month but not at birth. These bands represent a transitional stage in the formation of the striae, although they do not always leave striae when they disappear. Inner, more dense nuclei, apparently formed some weeks previous to birth, have been observed in the tarsal bones of newborn infants. They tend to fade, beginning in the center, and disappear entirely in two months or less.

Sontag suggests that the first two phenomena described, which are not present at birth, may be the effects of a slowing or cessation of growth at birth, perhaps resulting from the shock of birth itself or from the chemical readjustments that occur in the first few days of postnatal life. The inner nuclei present at birth may well represent a change in growth or a shift in the supply of minerals or hormones which pass into the fetal circulation through the placenta.

These observations were made during examination of the skeletal roentgenograms of 98 children taken at the age of one month in lateral projections of the tarsal bones.—*R. S. Bromer.*

GILLESPIE, JAMES B., and SIEGLING, JOHN A. Melorheostosis Léri. *Am. J. Dis. Child.*, June, 1938, *55*, 1273–1279.

In this paper a case of melorheostosis involving the right lower extremity with associated scleroderma is reported. Congenital scleroderma associated with melorheostosis is apparently rare.

Kraft summarized four theories of the etiology of the condition: (1) a vasomotor neurosis in which the flow of blood to the affected part is altered, (2) an infectious process, (3) a constitutional endocrine disturbance and (4) an embryonic defect such as a metameric disturbance. In addition, Moore and de Lorimier suggested the possibility of congenital or developmental subperiosteal telangiectasis. The fact that pathologic changes were not seen in roentgenograms of the affected limb taken when the patient was one month of age would tend to rule out the embryonic theory.

Roentgen findings in the authors' patient were a loss of trabeculation with alternate areas of osteosclerosis and of rarefaction, extending vertically, in the right ilium, sclerosis of the right pubic bone, similar areas of rarefaction and sclerosis in the neck of the right femur, marked thickening of the cortex with scattered areas of rarefaction and sclerosis in the shafts of the right femur and tibia and less marked similar changes in the right metatarsals and phalanges. The bones of the right lower extremity were considerably shorter than those of the left.

The scleroderma was confined to the affected limb which suggests that the condition is related to the melorheostosis. There was no suggestion of a hereditary factor.

There is no known treatment for melorheostosis and the symptoms are usually treated symptomatically. Roentgen therapy has been attempted empirically on the assumption that subperiosteal telangiectasis exists, but no definite regression or improvement has been reported. In the case here reported, there seemed to be some improvement of the scleroderma under massage carried out over a long period of time.—*R. S. Bromer.*

BLUMENTHAL, SIDNEY, and LESSER, ARTHUR. Acute phosphorus poisoning. *Am. J. Dis. Child.*, June, 1938, *55*, 1280–1287.

A case of acute phosphorus poisoning, due to ingestion of roach paste, with recovery in an infant is reported in this paper. Yellow phosphorus has practically no local irritating effect on the stomach. It is rapidly absorbed and symptoms of poisoning usually do not become apparent until damage to the liver has progressed to the point of hepatic insufficiency. Usually this insufficiency occurs after a period varying from six to twelve hours to about two days, when vomiting and diarrhea start. The liver is tender to palpation and enlarges very rapidly. Jaundice becomes apparent and is soon followed by evidence of severe hypoglycemia, frequently terminating in convulsions and death.

Roentgenograms of the patient showed the presence of the typical "Phosphorschicht," or the dense band at the ends of the diaphyses of the long bones. The fact is emphasized that roentgenograms taken two to four weeks after the ingestion of the poison failed to show metallic lines. The typical phosphorus band was first noted in the roentgenograms taken six months after the poisoning.

The method of treatment is discussed in detail. The results of the studies of the blood chemistry are compared with those in previously reported cases.—*R. S. Bromer.*

SANDERSON, GEORGE, H., and SMYTH, FRANCIS SCOTT. Chondrodysplasia (Ollier's disease); a report of a case resembling osteitis fibrosa cystica. *J. Bone & Joint Surg.*, Jan., 1938, *20*, 61–67.

Sanderson and Smyth state the purpose of their paper is to report conditions where the resemblance of chondrodysplasia to osteitis fibrosa cystica might lead to confusion as to the diagnosis. The patient whose case is reported showed longitudinal striations in the roentgenograms affecting the ends of the diaphyses of almost all the long bones in both legs and the right arm. In the ends of the diaphyses there were also irregular spotted depositions of calcium, a gouged-out appearance in some places, and numerous spherical areas having the appearance of bone cysts such as are seen in osteitis fibrosa cystica. There was no generalized granular osteoporosis and generalized cortical thinning such as is usually found in the latter. Clinically there was also lacking the usual asthenia and weakness, polyuria, and anemia which are characteristic of von Recklinghausen's disease. The metabolic study showed no radical departure from the normal, which of-

fered a definite differential criterion from osteitis fibrosa cystica where hypercalcemia, hypophosphatemia, elevated phosphatase and a markedly negative calcium balance are associated with a preponderant urinary excretion of calcium.

Their case differed from those described as "Ollier's disease" where the distribution is usually asymmetrical.—*R. S. Bromer.*

Freeman, J. Morquio's disease. *Am. J. Dis. Child.*, Feb., 1938, *55*, 343–355.

Morquio in 1929 described 2 cases of familial and generalized osseous dystrophy, similar in many features to previously reported cases of achondroplasia, or chondro-osteodystrophy, yet impressing one as involving a separate syndrome. Freeman reports one case of this condition which seems to be identical with the clinical syndrome described by Morquio. The patient showed many of the characteristic features of Morquio's cases, though to a lesser degree than the photographs of the latter would indicate. Clinically there were dwarfism, kyphosis, genu valgum, pes planus, muscular flabbiness and certain ocular symptoms.

Roentgenologically, generalized and symmetrical osseous changes were noticeable: decalcification, deformity and destruction of epiphyses, delayed osseous development, peculiar appearance of the ends of the diaphyses of the long bones, typical changes of the vertebrae and shortening of the fibulas. No pathologic changes were found in the skull. Other features described by Morquio were absent in this case. No definite familial tendency could be ascertained. The calcium metabolism was normal and could not be held to account for the profound disturbance in the osteogenesis, as was considered possible in Morquio's cases.

Some authors have classified Morquio's disease as one of the several types of osteochondrodystrophy. It seems that the general opinion held today is that Morquio's disease is an independent, generalized and familial osteochondrodystrophy.—*R. S. Bromer.*

Caffey, John. Lead poisoning associated with active rickets; report of a case with absence of lead lines in the skeleton. *Am. J. Dis. Child.*, April, 1938, *55*, 798–806.

Caffey states that physicians have come to place great reliance upon the roentgen diagnosis of plumbism and this confidence is well grounded by the experience of Park, McKhann and Vogt, himself and others. He was surprised to encounter the patient whose case he reports in this paper who showed active rickets of long standing and also evidence of chronic lead poisoning but nevertheless failed to show lead zones at the ends of the bones. There can be little question that both chronic lead poisoning and active rickets were present synchronously in his patient. The history of the ingestion of lead, the basophilic stippling in the erythrocytes, the glycosuria, the excessive protein content of the cerebrospinal fluid and, finally, the presence of lead in the urine were all indicative of plumbism. The roentgenograms showed unmistakable rickets. An appearance of a new provisional zone of calcification and the progressive calcification of the intermediate zone are pathognomonic of healing rickets.

He thinks the failure of the lead line to develop in bones during the course of active rickets can be explained by the close parallelism between the metabolism of lead and the metabolism of calcium, which has been demonstrated in animals. Aub and his coworkers showed that lead, like calcium, is deposited in bone as a phosphate rather than uniting directly with the proteins of organic matter. They also demonstrated that viable cartilage has the power to remove lead as well as calcium from its surrounding medium *in vitro*. They concluded from their experimental studies that since both lead and calcium held in the body at a common site, and since the chemical behavior of their salts *in vitro* is similar, it is probable that the same physiologic conditions favor the liberation or the retention of the two. These same investigators have emphasized the fact that the persistence and increase of the calcified preparatory cartilage is by far the most striking phenomenon produced by lead in a growing bone. This is the source of the heavy transverse shadow cast at the ends of the bones of patients with lead poisoning. Since an essential feature of active rickets is the failure of calcification of the preparatory cartilage, it follows that when active rickets and plumbism are present in combination the lead lines cannot develop in the bones because calcification of the preparatory cartilage ceases. Thus when lead poisoning and active rickets are present in combination there are two antagonistic mechanisms in simultaneous operation in the preparatory cartilage—one (the result of lead poisoning)

causes an excessive calcification and leadification of the preparatory cartilage, while the second or the rachitic component prevents the deposition of calcium and lead in the same site.

There are several features in Caffey's case which lead him to believe that the rickets was not caused by a deficiency of vitamin D. Both the development of rickets during the administration of amounts of cod liver oil which are usually sufficient for prevention, and its virtually spontaneous healing, raise the question as to whether the presence of rickets in this patient might not be better explained on a dietary basis; that is, whether the intake of lead might not have produced low phosphate rickets.—*R. S. Bromer.*

WALLGREN, ARVID. Rheumatic erythema nodosum. *Am. J. Dis. Child.*, May, 1938, *55*, 897–912.

Wallgren discusses the conception that erythema nodosum is an expression of rheumatism, which dates back to Mackenzie (1886). In England this theory was the prevalent opinion for at least two or three decades. During the last fifteen or twenty years, the theory of a rheumatic cause has lost ground proportionately as the evidence has become more convincing that erythema nodosum is, as a rule, caused by tuberculosis.

Wallgren reports 2 cases in which the patients had both positive tuberculin reactions and rheumatic endocarditis. He believes that in these instances the erythema nodosum was the result of the tuberculous infection. In each case there was roentgen evidence of a primary tuberculous complex.

The third case reported is that of a boy of eleven years of age who had negative tuberculin reactions and no evidence of tuberculosis in the roentgenograms of his chest. He had pains in his joints on admission with fever and erythema nodosum. The diagnosis of rheumatic fever was later proved by the development of clinical signs of endocarditis.

The last case, Wallgren believes, proves the correctness of Mackenzie's view that acute rheumatic fever may give rise to erythema nodosum. On the other hand, the rarity of such a case (1 in 800 observed cases of erythema) indicates that Mackenzie was in error when he stated that erythema nodosum is frequently rheumatic. Erythema of this type is one of the exceptions that, in children, erythema is tuberculous. Evidently acute rheumatic fever can be classified among the nontuberculous diseases capable of producing erythema nodosum.—*R. S. Bromer.*

PORTIS, ROBERT B. Pathology of chronic arthritis of children (Still's disease). *Am. J. Dis. Child.*, May, 1938, *55*, 1000–1017.

Portis presents the clinical histories and necropsy observations for 2 children with chronic arthritis, which began at the ages of seven and 11 years, respectively, until their deaths. The disease complex was similar to that first described by Still. The latter included in the disease complex, which has since often been referred to by his name, chronic nonspecific joint disease, which involved mainly the periarticular tissues, generalized lymphadenopathy and splenomegaly. An additional abnormality in Portis' cases was generalized amyloidosis, and both patients died in uremia.

Portis discusses the cases in relation to those of Still, in 3 of which necropsy was done, and in relation to 12 similar cases from the literature for which necropsy observations were available. In 5 of the latter 12 cases there was generalized amyloidosis, and in 3, the kidneys were markedly infiltrated with amyloid. In some of the other cases, including those of Still, amyloidosis was not ruled out by microscopic examination. The articular changes observed at necropsy corresponded with the usual appearance of chronic proliferative arthritis at various stages, depending on the duration of the disease at the time of death. In none of the cases was there any evidence during life or conclusive evidence at necropsy of bacteremia, active tuberculosis, syphilis or rheumatic fever. Although Portis suggests no etiologic theory, he believes that the association of the clinical course and the pathologic changes is more than coincidental and that the cases represent a disease entity.—*R. S. Bromer.*

GHORMLEY, JOHN W. Ossification of the tendo achillis. *J. Bone & Joint Surg.*, Jan., 1938, *20*, 153–160.

Ossification of the tendo Achilles is a definite yet rare, clinical entity. Usually the ossification results from heterotopic bone formation arising within the body of the tendon; sometimes it develops from the periosteum of the os calcis. Various authors offer many possible explanations of this condition. It is suggested that the

ossification may be: (1) an embryonic rest or inborn anomaly; (2) a neoplastic growth; (3) a sesamoid bone such as is found in the tendons of birds; (4) osteogenesis from osteoblasts circulating in the blood stream; (5) growth of bone from a torn or injured periosteum; (6) chronic infection; (7) trophic disturbance due to tabes dorsalis; (8) bone formation by osteoblasts which have taken over a bone-forming function; (9) bone formation by osteoblasts which have metamorphosed from fibroblasts.

Ghormley's case was a white male, aged forty-two. He had had a trauma eleven years previously when he fractured his os calcis on the same extremity. The fact that he had at the time when first observed a deficiency of the neural arch of the first sacral segment suggests the possibility that the ossification of the tendo Achilles might have been an associated congenital anomaly. In 4 of the cases reported by other writers, a congenital talipes was present. Ghormley thinks the possibility of a congenital cause of this condition must be considered.—*R. S. Bromer.*

McMaster, Paul E. Influence of venous stasis on the production of chronic arthritis. *Arch. Surg.*, Nov., 1937, *35*, 833–840.

Chronic arthritis of the joints of the ankle or foot could not be demonstrated roentgenographically in 21 of 30 cases of long-standing passive congestion and edema of these parts resulting from nonulcerated varicose veins.

In 9 of the 30 cases there was roentgenographic evidence of chronic arthritis of the joints of the ankle and foot, but in each there was associated ulceration of the leg or near the ankle joint in addition to the passive congestion from existing varicose veins.

Ossifying periostitis of either the tibia or the fibula or both did not occur from venous stasis alone but did occur in 7 cases in which ulcerous lesions existed with the varicose veins.—*L. H. Osmond.*

Connor, Charles L. Clinically demonstrable bone changes in leukemia. *Am. J. Cancer*, Jan., 1937, *29*, 20–24.

The roentgenographic findings of 2 children suffering from lymphatic leukemia accompanied by bone changes are presented. The autopsy which was available in only one case revealed tumor cells growing beneath and elevating the periosteum. In the 2 cases presented, subperiosteal infiltration and secondary bone formation was the chief finding, although osteosclerosis and osteoporosis are the findings most frequently reported. Most of the bone lesions of leukemia occur in children, and the pelvis, spine and upper ends of the humeri and femora are the most frequent sites. Pain occasionally accompanies the bone changes and pathological fractures occur infrequently. The various manifestations of bone changes in leukemia frequently make difficult the differential diagnosis from rheumatic arthritis, osteomyelitis, scurvy, luetic periostitis, myeloma or chloroma and local osteolytic process.—*J. S. Weber.*

Voss, H. Über die parostalen und paraartikulären Knochenneubildungen bei organischen Nervenkrankheiten. (Parosteal and para-articular bone formation in organic nervous diseases.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, May, 1937, *55*, 423–441.

During the war there was often observed in cases with transverse lesions of the cord an ossification of the soft parts in paralyzed segments. However, such heteroplastic ossification has been noted not only in traumatic lesions, but also in transverse myelitis, in cord tumors and in syphilitic and tuberculous infections as well as in anterior poliomyelitis and syringomyelia. Much less often is new bone formation seen in cerebral lesions and diseases of the peripheral nerves. After reviewing the pertinent literature, the author presents 4 cases of his own.

The first patient was a male, aged fifty-seven, with compression of the cauda equina apparently as the result of an old tuberculous spondylitis involving the lumbar vertebrae. He exhibited extensive ossification in the soft tissues about the right hip. The other joints were not remarkable except for some slight arthritic changes about the left hip.

The second patient was a woman, aged fifty, with a left-sided hemiplegia as a result of cerebrospinal syphilis. Seventeen months after the onset of the paralysis, an examination of the left hip because of stiffness in the joint revealed extensive ossification of the periarticular tissues.

The third patient, a man aged fifty-eight, suffered neurological and psychic disturbances following a severe skull injury. Death occurred eleven months later as the result of pneumonia, and the autopsy showed an old area of softening

in the left central hemisphere. A roentgen examination of the pelvis five months after the injury revealed extensive ossification in the soft tissues about the right hip joint and calcification of the ligaments about the right knee. Slight changes of a similar nature were noted about some of the other large joints.

The fourth patient, a woman aged twenty-six, had severe psychic disturbances as the result of hemorrhage from an intracranial hemangioma with a left-sided paralysis. A roentgen study of the pelvis six months after the onset revealed fixation of the left hip as the result of widespread ossification in the region of the lesser trochanter and the medial aspect of the femoral neck.

The ossification in the author's cases and in those reported in the literature occurs in the paralyzed extremity and particularly about the larger joints (shoulder and hip). This is to be distinguished from the ossification which occurs in myositis ossificans. In the cases reported no significant changes have occurred in the bone and joint structures themselves so that the findings are regarded as distinct from those associated with arthropathies. As regards the pathogenesis of the ossification, the same problems and questions arise as in traumatic myositis ossificans.—*W. A. Evans, Jr.*

BURCH, GEORGE E., and SODEMAN, WILLIAM A. Hereditary hypoplasia of the mesenchyme. (Blue sclerotics and brittle bones.) *Am. J. M. Sc.*, Dec., 1937, *194*, 844–845.

The authors noted blue sclerae in a boy, aged fourteen, who was under treatment for acute hemorrhagic nephritis. Five years previously he had had a fracture of the humerus. Roentgenography revealed a moderate degree of arthrokatadysis. Information was obtained regarding 76 individuals in five generations of the family. Forty-one of these (53.9 per cent) were found to have some of the characteristics of this condition. Every affected individual had an affected parent. The condition was transmitted 10 times by females and 3 times by males. Twenty-four of those affected were females; 17 were males; 17 were known to have had one or more fractures; 4 had varying degrees of deafness. Three of the affected individuals were small, with prominent bossae but many of the others were of larger stature.—*A. A. de Lorimier.*

HILLS, RALPH G., and MCLANAHAN, SAMUEL. Brittle bones and blue scleras in five generations. *Arch. Int. Med.*, Jan., 1937, *59*, 41–55.

Rickets, scurvy, syphilis, metastatic carcinoma, multiple myeloma, osteogenic tumors, bone cysts and hyperparathyroidism all produce changes which make bones either soft or fragile. There are many cases of deficiencies in the osseous architecture where the basis is less explainable. Babcock has classified these in the following manner:

1. Hereditary type—due to hypoplasia of the mesenchyme (resulting in brittle bones and blue scleras).
2. Non-hereditary congenital type—including the osteogenesis imperfectas, either congenital or "tarda" ("osteopsathyrosis"); these having either white or blue scleras.
3. Non-hereditary acquired type—osteosclerosis fragilis generalisata ("marble bones," or "Albers-Schönberg's disease").
4. Senile type—an osteoporosis.

Of the hereditary group, 55 per cent of the reported cases were females. All tended to be undersized, usually short and slender. Deformations resultant from fractures were numerous. Many showed anomalous cranial ossifications. The conspicuous blueness of the scleras was one of the most consistent features. Some observers have believed this to be due to abnormal thinness of the sclera; others insist that the dimensions of the wall are normal but that there is an increase in its transparency probably due to decreased content of lime salts. No known visual defects have been attributed to this. After the age of twenty or thirty, deafness is likely to develop. This has been found to be of the nature of an otosclerosis, with ankylosis of the stapediovestibular articulation. Bone conduction remains practically normal. In contrast to osteogenesis imperfecta, where fractures may be found at birth, trouble is unlikely during infancy but fractures occur off and on through childhood until puberty has been reached. As a rule, these heal promptly with little overgrowth of callus. Deformities result from malunion rather than bending, for these bones are hard and brittle. The fibrous structures about the joints are frequently loose and relaxed, allowing an unusual range of motion. Therefore, sprains and dislocations are common. Roentgenographically the density of the

entire bone is decreased, the cortex being thin, with a wide marrow cavity. There may be a conspicuous thinning of the metaphyseal extremities but the epiphyses are likely to appear more normal. Some have noted an excessive amount of calcification in the petrous portion of the temporal bone.

The etiology is by no means definite. Though many believe as Key has suggested that there is a hereditary hypoplasia of the mesenchyme, others have emphasized that many of the mesenchymal tissues are entirely normal in these individuals and moreover that there are oftentimes defects of ectodermal and entodermal tissues, as well. The parathyroids have been blamed but most cases have shown normal calcium and phosphorus values.

The authors believe that the diagnosis is founded on the presence of blue scleras, the other stigmas being unessential. However, most patients are first seen because of fracture and the diagnosis then substantiated because of noting the blue scleras and learning of that characteristic in one or both parent or their ancestors. Such cases demand scrupulous care to avoid injury.

The case reported was of a girl, aged ten, who had had four fractures of the bones of the forearms and subsequently a posterior dislocation of the hip. All of these were incurred by minimal traumata. Her scleras were abnormally blue. All joints showed increased relaxation. A study of her family tree revealed the fact that 27 of 51 members showed one or more characteristics of this condition. All were traced back to a common ancestor, a woman. Sixty per cent of those affected were females. Deafness was manifest in 57 per cent, though it was noted in only 25 per cent of the last two generations—illustrating its occurrence later in life.—*A. A. de Lorimier.*

Albright, Fuller; Sulkowitch, Hirsh W., and Bloomberg, Esther. Further experience in the diagnosis of hyperparathyroidism, including a discussion of cases with a minimal degree of hyperparathyroidism. *Am. J. M. Sc.*, June, 1937, *193*, 800–812.

It has been suggested that the relatively high incidence of hyperparathyroidism as reported from clinics in Boston and London might be due to local factors such as deficiencies in ultraviolet. The authors admit that such a lack would predispose to the development of rickets and that rickets is associated with parathyroid hyperplasia and that such changes in turn might lead to adenoma formation, but they doubt this factual relationship for the 35 cases recognized in their clinic. Due to the pigment protection the colored race is especially susceptible to rickets; yet hyperparathyroidism has not been found among them, especially. Many cases might have been referred to the authors' clinic due to the fact that the first case of hyperparathyroidism reported in America was of their clinic but 22 of the 35 cases were not referred. The reason for this large series of cases seems to be the recognition of cases which did not show evidence of bone disease. Osteitis fibrosa generalisata is not a necessary criterion. The hormone does not act directly upon bone tissue but rather on the phosphorus and calcium equilibria in body fluids.

One such case was recognized when serum calcium and inorganic phosphorus determinations were made because of a ureterolithiasis. The blood calcium was 11.3 mg. per 100 cc; the inorganic phosphorus, 2.3; rechecks showed 12.2 and 13.0 mg. for the calcium and 2.6 and 3.0 mg. for the inorganic phosphorus. No increased radiability of the skeleton could be noted and the serum phosphatase was normal. A subtotal parathyroidectomy was performed, removing 6.8 gm. (4 normal glands weigh about 0.11 to 0.13 gm.). A tibial biopsy showed normal osseous structure; no osteoclasts and no fibrosis, just fat cells and inactivity.

There were 12 such cases which had no clinical or roentgenographic evidence of bone disease; in only 8 was the skeleton involved and not the urological system; in 15, both systems were involved. Some showed very minimal hyperparathyroidism. Though many believe that 12.5 mg. is the lower limit of serum calcium for these cases, the authors have had several cases of lower values which presented other symptoms and findings supportive of the diagnosis. A consideration of the serum protein is very important; hyperparathyroidism increases the ionized calcium; that fraction may be high but if the calcium bound to protein is low, the total "serum calcium" may be normal. For instance, a case of nephrolithiasis which was found to have large excretions of calcium and phosphates in her urine, showed serum calcium values of 11.2, 10.2, 10.4, 11.5, 10.3 and 10.8 mg. per 100 cc. before operation, but her serum protein values were only 4.9 and 5.2 gm. (normal

about 6.5 gm.). Moreover, this patient excreted 263 and 222 mg. of calcium per 24-hour period, while on a low calcium diet (normal, about 65 mg.), and the stones were largely calcium phosphate and no other basis for their formation (no obstruction; no infection) could be found. A small adenoma was removed from one of the parathyroids; the serum calcium decreased to 9.0 mg.; the inorganic phosphorus increased from as low as 2.1 mg. to as high as 4.2 mg.

Another case showed marked changes in her skeleton with no supportive blood chemistry and no urinary evidence. An exploratory of the parathyroids was made because of an ununited fracture of nine months' duration and an adenoma measuring 1.2×0.8×0.4 cm. was removed.

In other cases abnormal serum calciums were found at times while at other times the values were entirely normal. The 24-hour urinary excretions of calcium were very informative. Increases in serum phosphatase were considered indicative of bone repair and not necessarily indicative of the severest degree of hyperparathyroidism. High serum phosphatase findings should caution the surgeon to resect rather than remove a complete tumor at one operation, for the greater the phosphatase the more likely there will develop a hypocalcemia after operation. In some cases the main evidence consisted of persistently low serum phosphorus values and the finding of calcium phosphate stones in the kidneys or ureter.—*A. A. de Lorimier.*

### BLOOD AND LYMPH SYSTEM

YATER, WALLACE M. Maintenance of the functional integrity of occluded large arteries as demonstrated by thorotrast arteriography. *Am. J. M. Sc.*, Sept., 1937, *194*, 372–376.

E. V. Allen noted collateral vessel extensions originating from a small artery, above an occluded segment, with anastomoses to the same artery to compensate for occlusion. These observations were possible because of thorotrast arteriography. All the cases concerned the upper extremity. The author reports similar findings in 3 cases of occlusion of a segment of main arteries of the lower extremities. One of the cases complained of excruciating pains in the thigh, about five minutes after an alcohol rub. After about an hour, these pains extended down to the leg and foot, where they persisted for ten days and then slowly disappeared. At first the leg and foot appeared blanched but, after three or four days, normal color gradually returned. Arteriography thirty-six days later visualized normal diameters for the femoral artery except for an abrupt interruption of it for a distance of several centimeters. Medium-sized collateral vessels appeared to have developed from muscular branches and their anastomosis with the collateral vessels about the knee. In the other 2 cases the development of symptoms was less acute. One of these developed ulcerations (gangrenous processes) which gradually healed. All seemed to show new anastomoses as collateral compensations to the occluded segments.—*A. A. de Lorimier.*

### GENERAL

GODFREY, M. J. Hydatid disease; clinical, laboratory and roentgenographic observations. *Arch. Int. Med.*, Nov., 1937, *60*, 783–804.

Hydatid disease has been reported from all countries but it is most prevalent where sheep are raised. In Australia and New Zealand there are 13 and 15 sheep, respectively, per capita. In Iceland, where there are approximately 2 sheep per capita, it has been reported that 28 per cent of the dogs are infected and autopsies have shown that 1 out of 6 persons has been a victim of the disease. Other regions where the condition is commonly found include Switzerland, France, Austria, Serbia, northern Italy and Russia.

The dog, wolf and jackal are the ideal hosts for the adult stages of the parasite; the ova are passed in the feces of these animals. When swallowed by intermediary hosts—sheep, cattle, pigs, or man (an accidental intermediary host)—the ova hatch in the stomach or duodenum. The embryo escapes and bores its way through the wall and into the portal vein; thereby it is swept into the liver where in the majority of cases it lodges. It may be destroyed by reaction of antibodies. If it survives, it becomes surrounded by small mononuclears; after about seventy-two hours, eosinophiles and endothelial cells appear; after about fourteen days, vesiculation occurs; the cytoplasm develops hyaline changes and fluid forms in the center of the mass. By the end of five months or so the cyst may develop to 1 cm. in diameter. It may continue to grow, with record dimensions such as to accommodate 11 gallons of hydatid fluid, or it may retrogress, with wrinkling and calcification of its laminated mem-

brane. The peripheral wall of the cyst is formed by the host; it is called the adventitia. Inside of it are two other layers: the ectocyst and the endocyst. The endocyst is the germinal layer which produces numerous brood capsules which are attached to it by fine pedicles and which float in the fluid contained in the cyst. Scolices develop within the brood capsules; these eventually contain two rows of hooklets and four suckers. When these cysts are ingested by a definitive host (dog, wolf or jackal), the scolices become attached to the walls of the small intestine and develop into worms of three or four segments. These adult forms measure about 5 mm. in length. They are about the same size as the villi of the small intestine and they lie parallel to them. As the terminal segments enlarge with ova, they rupture, freeing scores of ova which are carried out with the feces.

Dévé's studies of 2,727 cysts showed involvement of the liver in 76.6 per cent; of the lung, in 9.4 per cent; the muscles and cellular tissues, 5.2 per cent; kidney, 2.3 per cent; spleen, 2.1 per cent and rarely in the bones, orbit, brain, etc. Unless there be rupture, the symptoms are essentially mechanical; in case of leakage, various degrees of anaphylaxis may occur. Diagnosis is established by serological tests (precipitin —accurate in 65 per cent of cases; intradermal —accurate in 56 per cent of uncomplicated cases, and complement fixation test—indicative in about 52 per cent) and by roentgenography. About half of the cases show an increase of eosinophiles above 6 per cent. Roentgenographically, in cases of involvement of the liver, there may be elevation of the diaphragm or abnormalities in its contour, though the cysts usually develop in the lower portions of the liver (especially in the right lobe—probably due to the larger lumen and straighter course of the right hepatic vein). On the lower surface of the liver, the contours of the cysts may be visualized with cholecystography or by means of barium enema or barium meal studies, etc. The author suggests stereoscopic studies, using exposure technique as applied for spines. Of course the cysts are easily visualized if they contain calcium. Of pulmonary involvements, 65 per cent of the cysts were in the right lung especially in the base. The adventitia is thin and rupture into a bronchus is not uncommon. The result is a rush of salty tasting clear fluid into the mouth and perhaps the coughing up of "grape skins" (the daughter cysts). Roentgenographically these cysts are visualized as circular shadows. Hydatid disease of the kidney is rare because of the difficulty for the embryo to pass through both the hepatic and pulmonary filters. Roentgenographically these cysts have no distinctive appearance byt evidence of a cyst in a likely victim should prompt studies of the urine for scolices and the performance of the serological tests. The same holds in case of cysts occurring in the spleen. In bone, the cysts are likely to be multilocular and may simulate giant cell tumors, in particular.

Promiscuous needling of these cysts is to be condemned. There is the liklihood of contamination of healthy tissues and of secondary infection. Moreover, there is danger of hemorrhage or even drowning (in the case of pulmonary cysts) and anaphylactic reactions. The proper treatment is surgical excision with ample care to avoid contamination.—*A. A. de Lorimier.*

Smereker, Hilda. Untersuchung der Strahlungintensität in der Nähe radioaktiver Präparate mit dünnwandigen Ionisationskammern. (Study of the radiointensity in close proximity to radioactive preparations by means of thin-walled ionization chamber.) *Strahlentherapie*, 1937, *58*, 267–285.

A small cylindrical ionization chamber with wall thickness of 0.01 mm. aluminium afforded more accurate results in measurement of radiation intensity close to various radioactive preparations, mainly because of negligible "wall effect." With this new ionization chamber, experiments were conducted to determine the dependence of size and filter values and distance from preparation. These showed that the thin-walled chamber measurements, especially with increased thickness and lessened size filters, were markedly different in value as compared with standard measurements of thicker walled ionization chambers, with occasional discrepancies as marked as 60 to 70 per cent.

Employing this thin-walled ionization chamber, the value of 7.74 r was determined for 1 mg-hr. at 1.0 cm. distance from point source, with 0.5 mm. Pt filter.

The definition and experimental determination of Eve's constant is critically discussed, and it is shown that the quadrate theorem from which Eve's constant is derived is not applicable. From the author's studies, it is noted

that Eve's constant must lie below the accepted value.—*W. R. Stecher.*

HASCHÉ, ERWIN. Über eine Strahlenschutz- und Justieranordnung für Messungen von Röntgenstrahlen in absolutem Mass. (A radiation shield enabling an exact measurement of radiation.) *Strahlentherapie*, 1937, *58*, 170–173.

The appliance consists simply of a brass pipe, with inner surface lined with lead, which rests upon two steel supports. One end is fastened to a lead diaphragm which fits upon the filter holder site of the tube holder, the other end being attached to an ionization chamber. This affords exact and easily duplicated results, for the distance is fixed, and the radiation shield increases the exactness of measurements.—*W. R. Stecher.*

NITZGE, K. Hochspannungsschutz ohne technische Nebensorgen. (High tension protection without technical limitations.) *Strahlentherapie*, 1937, *58*, 178–183.

"Total-Protecta," as the new tube holder and tube is termed, is applicable for diagnostic and superficial therapy up to 125 kv., and rated at 115 kv. and 4 ma. continuous running. In addition it permits of a larger field of radiation than any models heretofore. This accomplishment is mainly due to the ingenious method of air cooling of the anode, which experimentally is as efficient as a water-cooled target. Mechanically the shock proofing has been improved so that a skin-target distance of 5.0 cm. is procurable. The latter is enhanced by the unique electron chamber device, which increases its efficiency. —*W. R. Stecher.*

REINHARD, M. C., and CANDEE, C. F. Observations on the use of a lead diaphragm to collimate an x-ray beam for treatment purposes. *Am. J. Cancer*, July, 1937, *30*, 577–582.

It was found that lead diaphragms used at distances of 17.5 cm. and 47.5 cm. did not produce the expected field when used with an XPT tube. Also the shape of the field was found altered by rotation of the lead diaphragm. The irregularities in the shape of the field were due to the shape of the focal spot, and for this reason they concluded that a lead diaphragm is not a satisfactory method of collimating the roentgen beam from the XPT tube.—*J. S. Weber.*

TAFT, ROBERT B. The radioactivity of thorium dioxide sol; preliminary report. *J. Am. M. Ass.*, May 22, 1937, *108*, 1779–1781.

The use of stabilized thorium dioxide sol (thorotrast) for roentgen visualization of the liver and spleen has become a well-established clinical procedure, but the question of its radioactivity and the resultant effect on the reticulo-endothelial system are far from settled. The Geiger counter offers a means of making observations of comparatively high accuracy. The author lists various experiments in making gamma-ray tests: (1) Comparison of the gamma-ray output of a clinical dose of thorium dioxide sol with a suitable radium standard. (2) The determination of the radioactivity of a phantom liver containing the entire clinical dose of thorium dioxide sol, to establish a basis from which to make percentage comparisons. (3) Tests made on the living patient who has been injected with thorium dioxide sol. (4) Tests on the liver of a patient, removed after death. (5) Tests on the ash of liver. As a preliminary step, the Geiger counter is set up and, with all possible sources of radioactive material removed from the vicinity, counts are made over long periods of time, to establish the number of impulses per minute which are being recorded from the cosmic radiation and any other sources. This is known as "base rate."

Conclusions drawn from the tests show that a clinical dose of thorium dioxide sol (75 cc.) gives the gamma-ray activity equivalent to approximate 1.37 micrograms of radium, and that little of this is excreted, the greatest part being stored in the liver and spleen, with some in the skeleton. The author beleives that the injection of thorium dioxide sol in doses of 75 cc. is a dangerous procedure, as the long continued bombardment of the reticulo-endothelial system by radioactivity will cause undesirable changes.—*S. G. Henderson.*

ROSENTHAL, MAURICE. Experimental radium poisoning. II. Changes in the teeth of rabbits produced by oral administration of radium sulphate. *Am. J. M. Sc.*, April, 1937, *193*, 495–501.

In 1924, Theodore Blum noted necroses and osteomyelitis involving the jaw of a painter of

luminous watch dials and he suggested that radium was the cause of this condition. Subsequently many such observations have been made clinically and recorded. The author's studies have been concerned with the effects within the teeth and their supporting membranes.

One hundred micrograms of radium sulphate were fed to each of 4 six months' old rabbits, over a period of ninety consecutive days. No abnormalities were noted during the first two months following this administration. During the third month, the lower incisors showed a brown mottling. This gradually increased and also formed on the other teeth. Within a few more weeks, transverse corrugations were noted on the extra-alveolar portions of the incisors. The longitudinal grooves of the labial surfaces of the upper incisors became more shallow. A definite gingivitis developed. Abrasion was progressive so that in the case of the rabbit which survived the longest (eighteen months) the lower incisors became worn down to the gum margin. The molars also showed a marked degree of wearing. Irregular masses of osseous tissue grew up between the teeth, producing a solid ankylosis. Abscesses developed in the jaws, and roentgenograms revealed rarefactions of the mandibular plates. Extracted teeth manifested radium content by their sensitizing film emulsion. Histological studies of the dentine showed areas of very poor calcification with irregularly distributed areas of excessive calcification. The intra-alveolar portions of the teeth showed irregular serration due to absorptions of the dentine and replacements by fibroblastic tissue. These same changes were noted in the center of dentine structure, indicating internal absorptions, and oftentimes such areas of internal absorption communicated with external cavitations. Hyperplasia of cementum, fibroblasts and true osseous tissue was so great that in some places where almost the entire intra-alveolar portions of the teeth had apparently been absorbed, there had resulted replacement by newly formed bone. There were no absorptions of the dentine which bordered the pulp cavity. The bone marrow of the alveolar processes was almost completely acellular and appeared myxomatous. The arterioles showed thickenings of the intima and obliterations. The pulp chambers were completely deranged with secondary dentine replacements. The enamel organs showed varying degrees of degeneration, even to the stage of necrosis. Cysts apparently arising from the periodontal membrane were numerous. Many of these showed infection. The gingival tissues also showed degenerations and proliferations, even to the stage of papillomatous changes.—*A. A. de Lormier.*

Zirkle, Raymond E., Aebersold, Paul C., and Dempster, Everett R. The relative biological effectiveness of fast neutrons and x-rays upon different organisms. *Am. J. Cancer*, March, 1937, *29*, 556–562.

*Drosophila* eggs, wheat seedlings and fern spores were subjected to the actions of fast neutrons and roentgen rays. Painstaking care was exercised to insure comparable results. Fast neutrons were produced by the cyclotron of the Radiation Laboratory of Berkeley and the roentgen rays were generated at 200 kv. constant potential and were filtered by 0.25 mm. tin, 0.5 mm. Cu and 1 mm. celluloid. Measurements were made with the Victoreen condenser type r meter. Amounts of each irradiation producing like amounts of ionization were considered comparable, although admittedly not equivalents.

Under these conditions, it was found that the fast neutrons were biologically more effective than the roentgen rays and also that the ratio of effectiveness of the various types of cells used differed significantly. The greater effectiveness of fast neutrons and the variability opens interesting possibilities in the field of therapeutics. —*J. S. Weber.*

Mottram, J. C. Production of epithelial tumours by irradiation of a precancerous skin lesion. *Am. J. Cancer*, August, 1937, *30*, 746–748.

Cramer's work (*Brit. J. Radiol.*, 1932, *5*, 618) was repeated using smaller doses of radiation. In contradistinction to Cramer's work, it was found that the incidence of warts was increased, roughly in direct relationship to the amount of radiation used. In 3 of the mice receiving 1,440 r of gamma radiation, which was the largest dose, and in one mouse receiving 480 r, the medium dose, the wart produced was histologically a cancer. The explanation is given that the dose delivered was the stimulating dose described clinically and which may be explained as a mutation phenomenon.—*J. S. Weber.*

BUTTERWORTH, J. S. Observations on the histogenesis of ovarian tumors produced in mice by x-rays. *Am. J. Cancer*, Sept., 1937, *31*, 85–99.

An increase in the incidence of ovarian tumors was an incidental finding in a series of irradiated mice and this paper is a study of the histogenesis of the tumors produced. Briefly, the summary and conclusions reached by the author are as follows:

In irradiated mice tubular adenomata are formed by the down-growth of the germinal epithelium of the ovary and the earliest of these appear six months after irradiation.

Granulosa cell tumors are derived from nests of follicle cells which form at the periphery of the ovary after irradiation and in senile mice proliferate to form tumors. These nests of cells are probably derived from normal follicles following degeneration of the ova.

Luteomata are usually formed indirectly by luteinization of granulosa cell tumors, but it is possible that they are occasionally formed directly by division and proliferation of lutein cells.

Granulosa cell tumors and luteomata of mice are similar to those of women, and it is unnecessary to postulate embryonic rests of granulosa cells to account for the histogenesis of granulosa cell tumors.

Several case histories, an extensive table of protocols, 12 photomicrographs and a generous bibliography are included.—*J. S. Weber.*

CATHIE, I. A. B., and DAVSON, J. Micro-incineration of epithelial tumours with regard to radiosensitivity. *Am. J. Cancer*, Nov., 1937, *31*, 471–475.

The authors refer to the observations of previous investigators who have suggested that the amount of radiation absorbed is directly dependent upon the amount of chromatin in the nucleus. The nucleus is most vulnerable to irradiation during mitosis, that is to say, during the most hyperchromatic phases. Malignant cells are more sensitive to irradiation than their normal prototypes, and the malignant nucleus is more hematoxyphil than the benign. By a technique of micro-incineration it was demonstrated that the inorganic content of cell nuclei corresponded with the chromatin material. Also that the inorganic salt content of the nuclei of malignant cells appeared higher than that of normal cells.

Since it has been suggested that the amount of chromatin in the nucleus is related to its radiosensitivity, and since the inorganic ash and the chromatin material have been shown to be coincident, an investigation into the relationship of the inorganic ash content of nuclei to tumor sensitivity appears to be indicated.

The authors examined 19 tumors; 9 were squamous cell and 10 basal cell carcinoma. The technique for incineration and examination is included in detail. In their discussion, they point out a definite difference in the amount and distribution of the inorganic ash between the less radiosensitive squamous cell carcinoma and the more radiosensitive basal cell tumors. The difference between the tumor groups in total ash may be explained in two ways. In the first place, there is more ash in individual nuclei in the basal cell tumors; in the second, there are a greater number of nuclei in a given area. Since so much discussion has centered around the tumor bed in radiosensitivity, the authors point out that no difference was observed between the inorganic ash content of the stroma in the two tumors. At the present time, investigations are being carried out with other classes of tumors known to be radiosensitive.—*E. E. Downs.*

STONE, ROBERT S. Skin reactions caused by 1,000 kilovolt and 200 kilovolt radiations. *Radiology*, Jan., 1938, *30*, 88–93.

From a study of the skin effects and depth dose measurements obtained by using 200 kv. (peak) and 1,000 kv. (peak) therapy, the author concludes that the real value in supervoltage lies in the treatment of very thick patients or when a very small field is used. The amount of energy absorbed in the depths as measured by a thimble chamber ionization meter, is not greater in many thin parts for 1,000 kv. (peak) than for 200 kv. (peak). The limiting factor in many instances is not the skin reaction but the reaction of the mucosa and other deep structures, whether 1,000 kv. or properly used 200 kv. radiations are employed. It is felt that severe skin or mucosal reactions are not justifiable when treating pelves. The results do not justify the immediate suffering nor the threat of late changes.—*J. H. Harris.*